Pretty Lake
Aquatic Vegetation Management Plan
2007-2011

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Executive Summary

Aquatic Control was contracted by the Pretty Lake Association (PLA) to complete aquatic vegetation sampling in order to create a lakewide, long-term integrated aquatic vegetation management plan. Pretty Lake is located 2.5 miles southwest of Plymouth in Marshall County, Indiana. This plan was created in order to more effectively document and control nuisance aquatic vegetation within the lake. This plan was also created as a prerequisite to eligibility for LARE program funding to control nuisance exotic vegetation.

Aquatic vegetation is an important component of Indiana Lakes. Aquatic vegetation provides fish habitat, food for wildlife, prevents erosion, and can improve overall water quality. However, as a result of many factors, this vegetation can develop to a nuisance level. Nuisance aquatic vegetation, as used in this paper, describes plant growth that negatively impacts the present uses of the lake including fishing, boating, swimming, aesthetic, and lakefront property values. The primary nuisance species within the Pretty Lake is the invasive exotic plant Eurasian watermilfoil (*Myriophyllum spicatum*). The negative impact of this species on native aquatic vegetation, fish populations, water quality, and other factors is well documented and will be discussed in further detail. The invasive exotic species curlyleaf pondweed (*Potamogeton crispus*) and purple loosestrife (*Lythrum salicaria*) were also present at low levels.

The primary recommendation for plant control within the Pretty Lake chain involves the use of fluridone to selectively control Eurasian watermilfoil throughout the lake. This type of treatment should preserve and enhance the population of native vegetation and relieve nuisance conditions created by Eurasian watermilfoil. The goal of this treatment is to eradicate Eurasian watermilfoil from Pretty Lake. This may be a difficult goal to achieve due to the abundance of this species in Marshall County and its ability to be easily transported from lake to lake. However, this plan will provide recommendations that will give the PLA the best chance for eliminating this species. An alternative plan would be to use systemic herbicides to spot treat areas of milfoil infestation. However, these types of treatments are not as effective as whole lake fluridone applications and annual retreatments would be needed. The cost of a whole lake fluridone treatment and related testing would be approximately $27,000.

Currently, there is an abundant and diverse native plant population present in Pretty Lake. A whole lake treatment may slow the growth of some of these species. If done properly, the treatment will not eliminate any of the beneficial vegetation with the exception of bur-marigold (*Bidens beckii*), which has a low tolerance to fluridone. Steps should be taken the following season to replace areas of bur-marigold that may be eradicated by the whole lake treatment. The cost of bur marigold harvest and re-introduction would be around $1,500. Due to the selectivity of fluridone, some native species may still require control if they reach nuisance levels.

In addition to the treatments, the plant community should be monitored for the next five years in order to assess the effectiveness of the controls, assess the response of the native community to the controls, and quickly detect any reinfestation of Eurasian watermilfoil. Surveys should consist of a summer Tier II survey in 2007-2011 along with reconnaissance surveys in the spring of 2008-2011 in order to search for any potential milfoil reinfestation. The plant sampling data should be presented in annual plan updates. The cost of sampling and plan updates should be around $4,000.

There is a noticeable lack of watershed and water quality information on this lake, so it is also recommended that the Association pursue funding for completion of a LARE funded Diagnostic Study. This type of study would be beneficial for identifying sources of nutrient pollution and allow for the adoption of measures that would preserve and enhance Pretty Lake water quality.

Acknowledgements

Funding for the vegetation sampling and preparation of an aquatic vegetation management plan was provided by the Pretty Lake Association and the Indiana Department of Natural Resources Lake and River Enhancement Program. Aquatic Control, Inc. completed the fieldwork, data processing, and map generation. Special thanks are due to Sue Palumbo and the Pretty Lake Association for their help in initiating and completing this project. Special thanks are given to Bob Robertson, District Fisheries Biologists for the Indiana Department of Natural Resources-Division of Fish And Wildlife, for his assistance and review of this plan. Special thanks are also given to Gwen White and Angela Studevant, Aquatic Biologist from the Lake and River Enhancement Program (LARE) for their review and assistance on this plan. Author of this report is Nathan Long of Aquatic Control. The author would like to acknowledge the valuable input from David Isaacs, Brian Isaacs, Joey Leach, Matt Johnson, Steve Lee, Kyle Richardson, Brendan Hastie and Barbie Huber of Aquatic Control for their field assistance, map generation, review, and editing of this report.

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1.0 INTRODUCTION

Aquatic Control was contracted by the Pretty Lake Association (CLA) to complete aquatic vegetation sampling in order to create a lakewide, long-term integrated aquatic vegetation management plan. The study area includes Pretty Lake, which is located southwest of Plymouth in Marshall County, Indiana. This plan was created in order to more accurately document the aquatic vegetation community and create a feasible plan for managing nuisance vegetation within the Pretty Lake. The plan is also a prerequisite to eligibility for the Lake and River Enhancement (LARE) program funding to control exotic or nuisance species. Two aquatic vegetation surveys were completed in 2006 in order to document the plant community. The surveys will provide valuable information that will allow for scientifically based recommendations for aquatic plant management. The focus of aquatic plant management will be on the control of exotic invasive species. However, some native vegetation in high-use areas will likely require some form of control.

The primary nuisance plant species in the chain of lakes is the exotic species Eurasian watermilfoil. The invasive exotic species curlyleaf pondweed and purple loosestrife were also detected. It is important to initiate management of these species in order to reduce nuisance conditions and stop their spread. In order to successfully manage aquatic vegetation on a public body of water concerns of fishermen, lot owners, biologists, and the general public will have to be addressed. The purpose of this plan is to provide plant management recommendations that will balance the concerns of these interest groups while effectively relieving Pretty Lake of nuisance aquatic plant growth while working towards the goals of the plant management program.

2.0 WATERSHED AND WATERBODY CHARACTERISTICS

Pretty Lake is an approximately 97 acre natural lake with a maximum depth of 40 feet and an average depth of approximately 13.0 feet (Figure 1). Pretty Lake is classified as mesotrophic, which means the lake is moderately productive. Secchi measurements taken during plant surveys in 2006 ranged from 14.0 feet in the spring survey to 15.0 feet in the summer survey. Measurements taken by Mr. Joseph Coury, a volunteer with the Indiana Clean Lakes Program, found Secchi depths to be between 15.0 and 17.4 feet in 2005.

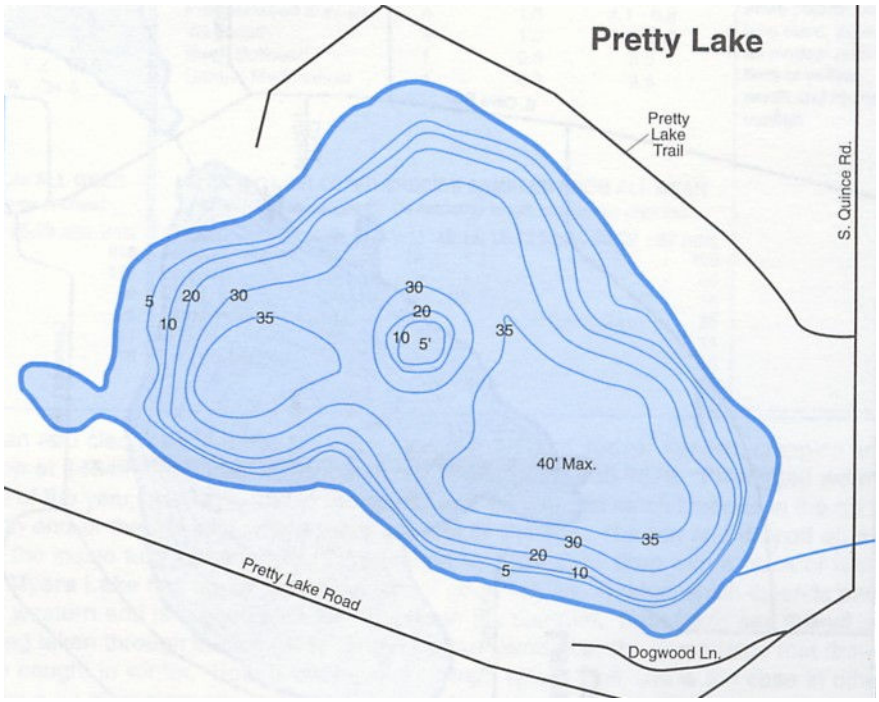

Figure 1. Pretty Lake Bathymetric Map (Indian Fishing Map Guide Vol. 2, 2002)

There is a severe lack of watershed data on Pretty Lake. Based on conversations with long-time residents, topographical map studies, and visual observations, it appears that the lake has a very small watershed. Reports from a publication titled "Pretty Lake History" tend to back up this theory (Pretty Lake Association, 2006). It is recommended that the PLA pursue funding for a Diagnostic Study so that this important watershed and in-lake water quality data can be gathered. The small Pretty Lake watershed received much needed improvement in 2006, when a new sewer system was installed for residents living around the lake. The new system should have excellent long-term effects on the overall water quality of Pretty Lake. The Pretty Lake Association was the driving force on getting the system installed.

3.0 PRESENT WATER BODY USES

Pretty Lake has historically been a summer get-a-way for residents of Marshall County and northern Indiana. Today, Pretty Lake is used for a variety of activities. An access site is located along the eastern shore. Virtually the entire shoreline of Pretty Lake is developed residentially. A small bay in the southwest corner and a small stretch of shore along the south side of the lake are the only remaining undeveloped areas (Figure 2). Fishing, boating, and swimming are popular activities on Pretty Lake. At a recent public meeting, lake users indicated that 100% used the lake for boating and swimming, 85% for fishing, and 10% used the lake for irrigation (survey included 20 individuals, all property owners on the Lake). Despite being less than 100 acres, high speed boating is allowed on Pretty Lake with certain limitations. In order for high speed boating to be allowed on the lake, the Association had to be in favor of this activity and petition IDNR. Boating over 10 mph can only take place from 1-4:00 P. M.

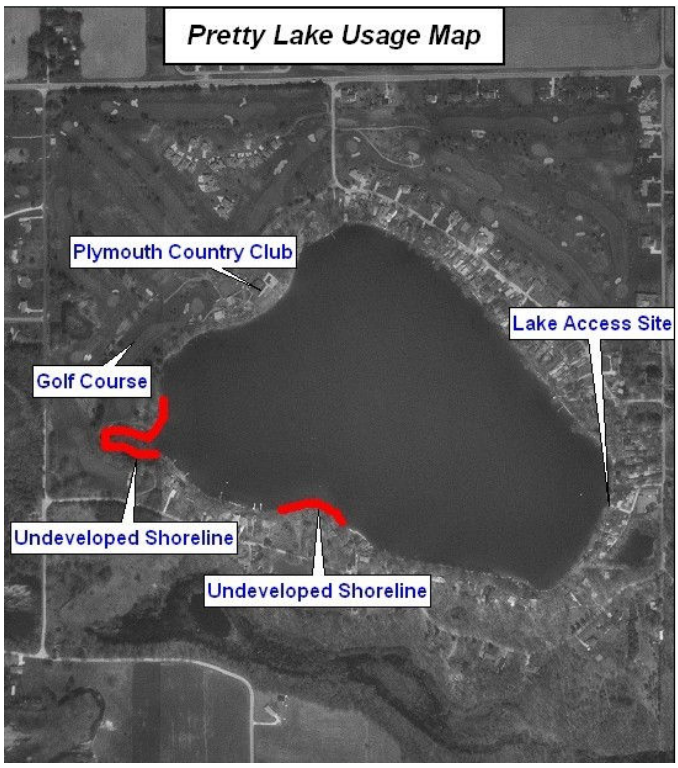

Figure 2. Pretty Lake Usage Map

4.0 FISHERIES

The only fish survey completed by IDNR on Pretty Lake took place June 17-21, 1968. Secchi disk readings were reported to be 5.2 feet and it appeared that sufficient oxygen levels were present to a depth of 15.0 feet. Watermilfoil (*Myriophyllum spp.)* was the dominant species and was approaching a problem density (milfoil was not identified to species). Species composition included bluegill (45%), redear (15%), yellow bullhead (13%), warmouth (11%), and largemouth bass (3%). Brown bullhead, pumpkinseed, yellow perch, and walleye were also collected. The survey stated that increased growth of aquatic weeds and the low percentage of predators may have increased detrimental effects on the panfish population. The survey report mentioned that the fish population in the lake could still be considered desirable. The study also concluded that it would be advantageous to initiate a weed control program in order to clean up the shoreline and reduce the amount of weeds, which would increase the numbers of small bluegill and redear available to predators. The report also mentioned the desire to create a public launch area on the lake (IDNR, 1968).

4.1 Aquatic Vegetation and Fish Management

Aquatic vegetation is an important component in fisheries management. Aquatic vegetation provides cover for adult and juvenile fish, supports aquatic invertebrates that are eaten by fish, and shelters small fish from predators. However, dense vegetation, especially Eurasian watermilfoil, can have negative effects of fish growth. Dr. Mike Maceina of Auburn University found that dense stands of Eurasian watermilfoil on Lake Guntersville proved to be detrimental to bass reproduction due to the survival of too many small bass. This led to below normal growth rates for largemouth bass and lower

survival to age 1. Maceina found higher age 1 bass density in areas that contained no plants verses dense Eurasian watermilfoil stands (Maceina, 2001). Bluegill growth rates can also be affected by dense stands of Eurasian watermilfoil. It is well known by fisheries biologists that overabundant dense plant cover gives bluegill an increased ability to avoid predation and increases the survival of small young fish, which can lead to stunted growth.

5.0 PROBLEM STATEMENT

Aquatic vegetation is an important component of lakes in Indiana. Aquatic vegetation provides fish habitat, food for wildlife, helps slow and prevent erosion, and can improve overall water quality. However, as a result of many factors, this vegetation can develop to a nuisance level. Nuisance aquatic vegetation, as used in this paper, describes plant growth that negatively impacts the present uses of the lake including fishing, boating, swimming, aesthetic, and lakefront property values. The primary nuisance species within Pretty Lake is the exotic species Eurasian watermilfoil. Curlyleaf pondweed is another submersed exotic species that is present in Pretty Lake and has the potential to create nuisance conditions. Purple loosestrife is an invasive exotic emergent species that was also detected during the 2006 sampling. This species will not likely create nuisance conditions for lake users, but could have negative impacts on native wetland species in and around Pretty Lake.

5.1 Problems Caused By Eurasian Watermilfoil

Eurasian watermilfoil is an exotic invasive species of submersed vegetation that was likely introduced into our region prior to the 1940's (Figure 3). This species commonly reaches nuisance levels in Indiana Lakes. Once established, growth and physiological characteristics of milfoil enable it to form a surface canopy and develop into immense stands of weedy vegetation, outcompeting most submersed species and displacing the native plant community. These surface mats can severely impair many of the functional aspects of waterbodies such as maintenance of water quality for wildlife habitat and public health, navigation, and recreation. Furthermore, a milfoil-dominated community can greatly reduce the biodiversity of an aquatic system and negatively impact fish populations (Getsinger et. al., 1997).

Figure 3. Illustration of Eurasian watermilfoil (Illustration provided by Applied Biochemist).

5.2 Problems Caused by Curlyleaf Pondweed

Curlyleaf pondweed is an invasive exotic submersed species that was likely introduced in the early 1900's. It is present in many Indiana natural lakes and manmade impoundments. Curlyleaf pondweed's wavy serrated leaves give it a rather unique appearance (Figure 4). Richardon's pondweed (*Potamogeton richarsonii*) is probably the only species that it can be easily confused with. Curlyleaf pondweed has the tendency to create dense surface mats in the spring and early summer. These mats can interfere with recreation and limit the growth of native species. Another problem associated with this species is caused by its summer die-off that tends to lead to algae blooms. The summer die-off also tends to lessen the impact of this species on lake recreation, so it is typically a secondary concern when compared to Eurasian watermilfoil problems which can persist throughout the summer.

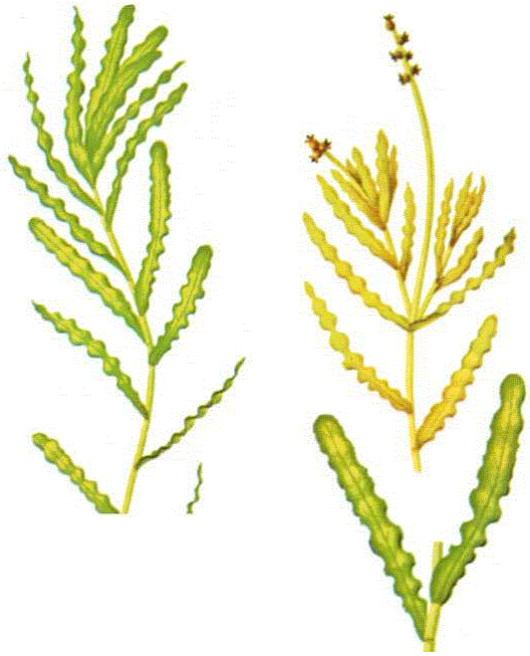

Figure 4. Illustration of curlyleaf pondweed (Illustration provided by Applied Biochemist).

5.3 Problems Caused by Purple Loosestrife

Purple loosestrife is an exotic invasive species of emergent vegetation that has invaded many wetlands and lake margins throughout Indiana (Figure 5). This species was introduced from Eurasia and became established in the estuaries of northeastern North America by the early 1800's. The impact of purple loosestrife on native vegetation has been disastrous, with more than 50% of the biomass of some wetland communities displaced. Impacts on wildlife have not been well studied, but indicate serious reduction in waterfowl and aquatic furbearer productivity (Thompson et. al., 1987).

Figure 5. Illustration of Purple Loosestrife (Illustration provided by Applied Biochemist).

6.0 VEGETATION MANAGEMENT GOALS

An effective aquatic vegetation management plan must include well-defined goals and objectives. Listed below are three goals formulated by LARE program staff and Division of Fish and Wildlife Biologists and approved by the Pretty Lake Association. The objectives and actions used to meet the objectives will be discussed in section 12.0. One must have a better understanding of the plant community before the objectives and actions can be discussed.

Vegetation Management Goals

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and fish and wildlife resources.

7.0 PLANT MANAGEMENT HISTORY

Shoreline herbicide treatments have been completed for the last several years on Pretty Lake. These treatments were designed to provide relief from nuisance conditions caused by native and exotic plant species. Treatment areas were funded by individual lot owners and were billed according to length of the shoreline. Treatment reports from 2005 indicate that Weed Patrol treated 15 acres of vegetation on June 23. It appeared that Eurasian watermilfoil was the primary species in the treatment areas. Aquatic Control completed the most recent treatment on June 28, 2006 to 3,556 feet of shoreline or approximately 7.55 acres (Figure 6). Diquat, endothal, and chelated copper herbicide were used in the treatment. Eurasian watermilfoil was the primary nuisance species in this area. Figure 7 illustrates the nuisance conditions found on Pretty Lake prior to treatment. The treatment effectively relieved nuisance conditions during the busy summer season. However, as reflected by the summer survey data, some Eurasian watermilfoil regrowth occurred by late summer, which is typical of contact herbicide treatments.

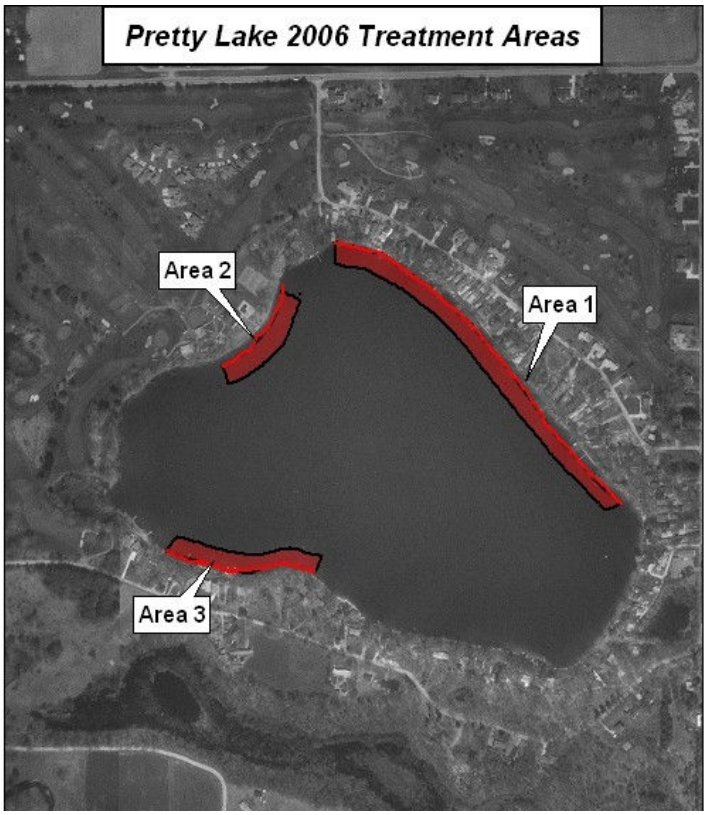

Figure 6. Pretty Lake, June 28, 2006 treatment areas.

Figure 7. Pretty Lake, nuisance conditions created by Eurasian watermilfoil, June 28, 2006.

8.0 AQUATIC PLANT COMMUNITY CHARACTERIZATION

Aquatic vegetation sampling must be completed in order to create an effective aquatic vegetation management plan. Sampling provides valuable data that allows managers to accomplish several tasks: locate areas of nuisance and beneficial vegetation; monitor changes in density, abundance, and location of native and exotic species; monitor and react to changes in the overall plant community; monitor the effectiveness of management techniques; and compare the Pretty Lake plant community to other populations. The only other plant survey data found was collected during the 1968 fish survey. A total of 15 species were observed during this survey. The survey indicated that milfoil was approaching problem density. Aquatic Control Inc. completed surveys in 2006. A Tier I survey was completed on June 6, 2006 and Tier I and II surveys were completed on August 16, 2006. Table 1 is a list of the scientific and common names of species collected from Pretty Lake in 2006.

Table 1. Scientific and Common Names of Species Collected From Pretty Lake in 2007.

Scientific Name	*Common Name*
Bidens beckii	Bur Marigold
Ceratophyllum demersum	common coontail
Chara spp.	Chara
Lythrum salicaria	purple loosesrtife
Myriophyllum heterophyllum	variable watermilfoil
Myriophyllum spicatum	Eurasian watermilfoil
Najas flexilis	slender naiad
Nuphar variegetum	spatterdock
Nymphaea tuberosa	white water lily
Nitella spp.	Nitella
Pontederia cordata	pickerel weed
Potamogeton amplifoilus	largeleaf pondweed
Potamogeton crispus	curlyleaf pondweed
Potamogeton foliosus	leafy pondweed
Potamogeton illinoensis	Illinois pondweed
Potamogeton pusillus	small pondweed
Potamogeton richardsonii	Richardson's pondweed
Typha latifolia	common cattail
Vallisneria americana	eel grass

8.1 Methods

8.1.1 Tier I Methods

The Tier I survey is also known as a reconnaissance survey. This method was developed to serve as a qualitative surveying mechanism for aquatic plants. This survey method serves to meet the following objectives:

1. to provide a distribution map of the aquatic plant species within a waterbody
2. to document gross changes in the extent of a particular plant bed or the relative abundance of a species within a waterbody

This survey strategy was augmented with the Tier II survey to gain more quantitative data if desired. The major advantage of this type of survey is the relatively small amount of time required to complete a survey. Prior to beginning a Tier I survey, information is gathered on the lake being surveyed. This information includes lake size, maximum depth, historical species lists, and historical Secchi depth data. The entire littoral zone (area of the lake which can grow vegetation) of the lake is briefly examined during the survey. A counter clock-wise path is taken around the littoral zone of the lake. While the boat is slowly zigzagging, aquatic plant abundances are recorded based on visual observation. Abundance rating are based on 1-4 increments with 1 being less than 2% and 4 representing greater than 61% abundance. Rake throws are made if there is dense surface cover or if there is difficulty in visually assessing plant species. The littoral zone is broken up into individual plant beds (plant beds are defined as contiguous consistent plant communities). Vegetation cover ratings, substrate types, and canopy coverage are also determined during the survey (IDNR, 2006).

8.1.2 Tier II Methods

The Tier II survey helps meet the following objectives:

1. to document the distribution and abundance of submersed and floating-leaved aquatic vegetation
2. to compare present distribution and abundance with past distribution and abundance within select areas

The number and depth of sampling sites are selected based upon lake size and classification (ten sites were sampled on Pretty Lake from 0-5 feet, 5-10 feet, 10-15 feet, and 15-20 feet). Once a site was reached the boat was slowed to a stop and the coordinates were recorded on a hand-held GPS unit and later downloaded into a mapping program. A depth measurement was taken by dropping a two-headed standard sampling rake that was attached to a rope marked off in 1-foot increments (Figure 8). An additional ten feet of rope was released and the boat was reversed at minimum operating speed for a distance of ten feet. Once the rake is retrieved the overall plant abundance on the rake is scored with either a 0 (no plants retrieved), 1 (1-20% of rake teeth filled), 3 (21-99% of rake teeth filled), or 5 (100% of rake teeth filled) and then individual species are placed back on the rake and scored separately.

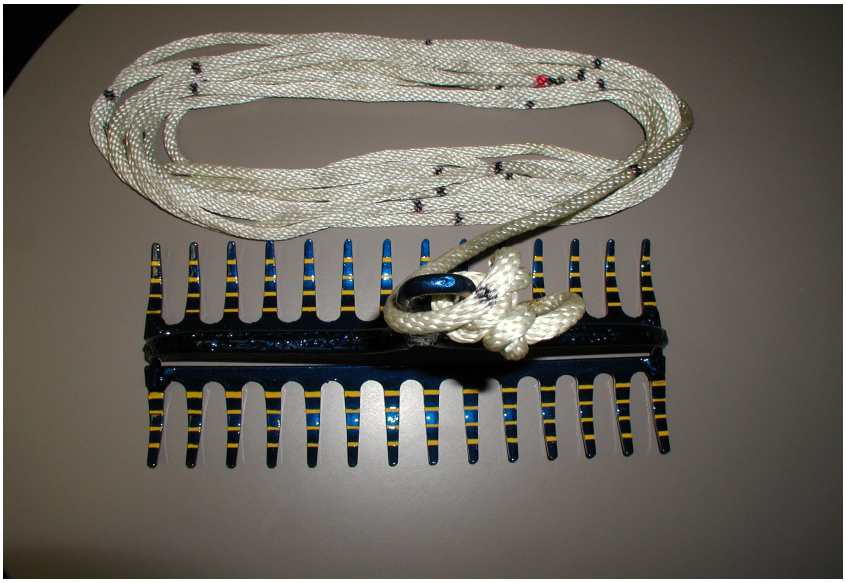

Figure 8. Sampling Rake

The data is used to calculate different lake characteristics and community and species metrics. The different characteristics and metrics calculated from the Tier II method are defined below:

Littoral depth: Maximum depth that aquatic vegetation is present.
Total sites: Total number of sites sampled.
Littoral sites: Number of sites within the littoral depth.
Secchi depth: Measurement of the transparency of water.
Species richness: count of all submersed plant species collected.
Native species richness: count of all native submersed plant species collected.
Maximum number of species per site: highest number of species collected at any

site.
Mean number of species per site: The average number of all species collected per littoral site.
Mean number of native species per site: The average number of native species per site.
Species diversity index: This is a modified Simpson's diversity index which is a measure that provides a means of comparing plant community structure and stability over time.
Frequency of occurrence: Measurement of the proportion of sites where each species is present.
Relative frequency of occurrence: Measures how the plants occur throughout the lake in relation to each other.
Dominance index: Combines the frequency of occurrence and relative density into a dominance value that characterizes how dominant a species is within the macrophyte community (IDNR, 2006).

8.2 Results

8.2.1 2006 Spring Survey

On June 6, 2006, Aquatic Control completed a Tier I survey on Pretty Lake. A Secchi measurement was taken and found to be 14.0 feet. The Tier I survey revealed 8 distinct plant beds within Pretty Lake totaling 30.8 acres. (Table 2 & Figure 9). Vegetation was present to a maximum depth of 23 feet. Seventeen different species were observed.

Table 2. Pretty Lake Tier I Survey Results, June 6, 2006

Lake: Pretty			**Number of plant beds: 8**					
Date: 6/6/06			**Number of species: 17**					
Secchi: 14.0			**Littoral zone size: 30.8**					
			Littoral zone max depth: 23					
Plant Bed I.D.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Plant Bed Size (acres)	**11.8**	**2.1**	**9.8**	**1.4**	**2.3**	**0.8**	**2.4**	**0.2**
largeleaf pondweed	2	-	2	1	1	1	3	-
Richardson's pondweed	2	1	1	-	-	1	1	1
Illinois pondweed	1	-	1	-	-	-	-	-
small pondweed	1	-	-	-	-	-	-	-
Eurasian watermilfoil	2	-	4	1	1	4	3	-
common coontail	2	-	2	-	-	2	1	-
white water lily	1	-	1	3	2	-	-	-
slender naiad	1	-	-	-	-	-	-	-
leafy pondweed	1	-	-	-	-	-	-	-
variable watermilfoil	1	-	-	-	-	-	-	-
curlyleaf pondweed	2	-	2	-	-	-	1	-
eel grass	1	1	1	1	1	-	-	1
Chara	1	2	1	3	2	-	-	1
common cattail	-	-	-	1	-	-	-	-
purple loosestrife	-	-	-	2	2	-	-	-
spatterdock	-	-	-	1	4	-	-	-
pickeral weed	-	-	-	1	1	-	-	-

*Rating based on score of 1-4 with 1 being least dense and 4 being most dense

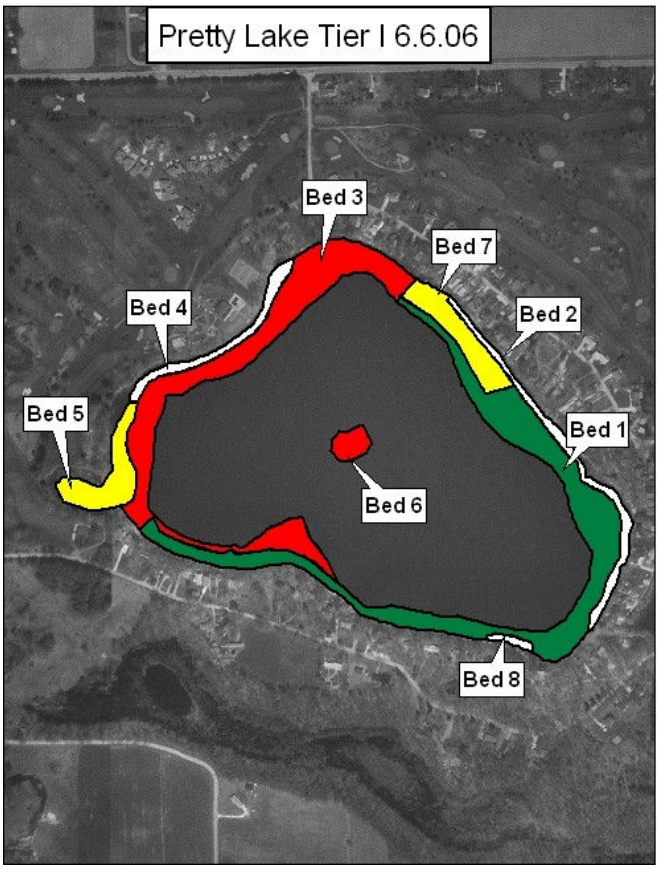

Figure 9. Tier I Plant Beds, Pretty Lake, June 6, 2006

Eurasian watermilfoil was the most abundant species present during the spring survey. Milfoil had reached the surface in many areas of Pretty Lake and was present in all plant beds with the exception of bed 2. Milfoil was present at an abundance rating of 2 or higher in plant beds 1, 3, 6, and 7. These beds totaled 24.8 acres. Bed 3 was the most impaired by dense milfoil. This bed was located along the shoreline and out several hundred feet along the northwest side of Pretty Lake.

Curlyleaf pondweed was not as dense or abundant as Eurasian watermilfoil. It was observed in only three plant beds. Curlyleaf pondweed received an abundance rating of 2 in beds 1 and 3.

Despite having dense beds of invasive species, there was still a good diversity of beneficial native vegetation. Largeleaf pondweed (*Potamogeton amplifolius*) was dense and abundant in plant bed 7. Other beneficial pondweeds were scattered throughout the littoral zone of Pretty Lake. The largest area of rooted floating vegetation was in bed 5, which was located along one of the only undeveloped areas of Pretty Lake.

8.2.2 2006 Summer Survey

On August 16, 2006, a second round of sampling was completed. Sampling consisted of a Tier I and Tier II survey.

Summer Tier I survey

The Tier I survey was completed prior to a Tier II survey. A Secchi measurement was taken prior to the survey and found to be 15.0 feet. The Tier I survey revealed 5 distinct plant beds containing nine different species totaling 32.4 acres. (Table 3 & Figure 10). Vegetation was present to a maximum depth of 20 feet.

Table 3. Pretty Lake Tier I Survey Results, August 16, 2006.

Lake: Pretty			**Number of plant beds: 5**		
Date: 8/16/06			**Number of species: 9**		
Secchi: 15.0			**Littoral zone size: 32.4**		
			Littoral zone max depth: 20+		
Plant Bed I.D.	**1**	**2**	**3**	**4**	**5**
Plant Bed Size (acres)	**9.3**	**6.8**	**12.2**	**1.7**	**2.4**
Eel grass	4	2	3	-	-
Illinois pondweed	3	2	2	1	1
largeleaf pondweed	3	-	-	-	-
Chara	3	3	1	4	4
Eurasian watermilfoil	3	2	3	-	-
common coontail	4	-	2	1	1
white water lily	-	-	-	4	-
spatterdock	-	-	-	-	4
purple loosestrife	-	-	-	-	1

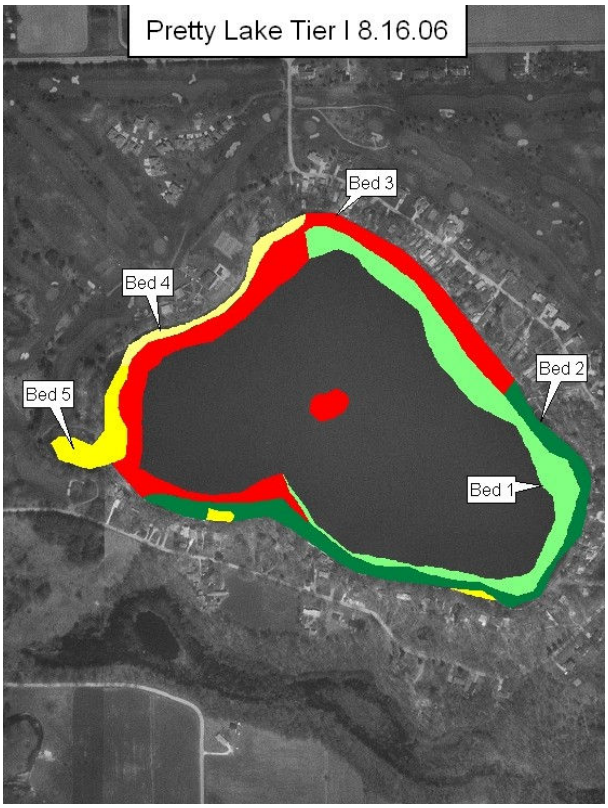

Figure 10. Tier I Plant Beds, Pretty Lake, August 16, 2006

There were fewer species observed during the summer survey, but that may have been due to the fact that a different biologist completed the survey (the detail put into a Tier I survey is still somewhat left to the interpretation of the individual). Eurasian watermilfoil was still abundant in Pretty Lake. It was only observed in three of the five plant beds, but received a score of 3 in beds 1 and 3, which totaled 21.5 acres. It appeared that Illinois pondweed (*Potamogeton illinoensis*) and eel grass (*Vallisneria americana*) were much more abundant in the August survey than the June survey. Curlyleaf pondweed was not observed during either the Tier I or II survey. Rooted floating vegetation was abundant in plant bed 5.

Summer Tier II survey

Tier II sampling took place on August 16, 2006 immediately following the Tier I sampling. Plants were present to a maximum depth of 20.0 feet. Forty sites were selected within the littoral zone. The number and depth of the sites was determined prior to the survey and based on lake size and trophic status. Ten sites were sampled from 0-5 feet, 5-10 feet, 10-15 feet, and 15-20 feet. Results of the sampling are listed in Table 4. Overall vegetation density and abundance is illustrated in Figure 11. A total of 10 species were collected of which 9 of the species were natives. The maximum number of species collected at a site was 4 and the mean species collected per site was 2.25 while the mean number of native species collected per site was 1.78.

Table 4. Occurrence and abundance of submersed aquatic plants in Pretty Lake, August 16, 2006.

Occurrence and abundance of submersed aquatic plants in Pretty Lake							
County:	Marshal	Sites with plants:	39	Mean species/site:	2.25		
Date:	8/16/2006	Sites with native plants:	37	Standard error (ms/s):	0.15		
Secchi (ft):	15	Number of species:	10	Mean native species/site:	1.78		
Maximum plant depth (ft):	20	Number of native species:	9	Standard error (mns/s):	0.12		
Trophic status	Mesotrophic	Maximum species/site:	4	Species diversity:	0.81		
Total sites:	40			Native species diversity:	0.70		

All depths (0 to 20 ft)	Frequency of	Rake score frequency per species				Plant Dominance	
Species	Occurrence	0	1	3	5		
eel grass	52.5	47.5	2.5	5.0	45.0	26.5	
Eurasian watermilfoil	47.5	42.5	2.5	10.0	35.0	24.5	
Illinois pondweed	47.5	42.5	2.5	12.5	32.5	26.5	
common coontail	45.0	55.0	2.5	7.5	35.0	39.0	
slender naiad	15.0	85.0	0.0	2.5	12.5	5.0	
Chara	5.0	95.0	0.0	0.0	5.0	1.0	
small pondweed	2.5	97.5	2.5	0.0	0.0	0.5	
largeleaf pondweed	2.5	97.5	0.0	0.0	2.5	2.5	
bur marigold	2.5	97.5	0.0	0.0	2.5	2.5	
Nitella	2.5	97.5	0.0	2.5	0.0	0.5	
Depth: 0 to 5 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**	
Species	**Occurrence**	**0**	**1**	**3**	**5**		
eel grass	70.0	30.0	0.0	10.0	60.0	34.0	
Illinois pondweed	50.0	50.0	0.0	20.0	30.0	30.0	
Eurasian watermilfoil	50.0	50.0	0.0	10.0	40.0	26.0	
Chara	10.0	90.0	0.0	0.0	10.0	2.0	
slender naiad	10.0	90.0	0.0	10.0	0.0	2.0	
largeleaf pondweed	10.0	90.0	0.0	0.0	10.0	10.0	
bur marigold	10.0	90.0	0.0	0.0	10.0	10.0	
Depth: 5 to 10 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**	
Species	**Occurrence**	**0**	**1**	**3**	**5**		
Eurasian watermilfoil	80.0	20.0	0.0	10.0	70.0	52.0	
Illinois pondweed	60.0	40.0	0.0	10.0	50.0	48.0	
eel grass	40.0	60.0	0.0	0.0	20.0	20.0	
common coontail	30.0	70.0	0.0	10.0	20.0	30.0	
slender naiad	20.0	80.0	0.0	0.0	20.0	8.0	
Chara	10.0	90.0	0.0	0.0	10.0	2.0	
Depth: 10 to 15 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**	
Species	**Occurrence**	**0**	**1**	**3**	**5**		
common coontail	70.0	30.0	0.0	0.0	70.0	62.0	62.0
eel grass	70.0	30.0	0.0	10.0	60.0	46.0	46.0
Eurasian watermilfoil	40.0	60.0	0.0	20.0	20.0	16.0	16.0
slender naiad	20.0	80.0	0.0	0.0	20.0	8.0	8.0
Illinois pondweed	20.0	80.0	0.0	10.0	10.0	8.0	8.0
Depth: 15 to 20 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**	
Species	**Occurrence**	**0**	**1**	**3**	**5**		
common coontail	80.0	20.0	10.0	20.0	50.0	64.0	
Illinois pondweed	60.0	40.0	10.0	10.0	40.0	20.0	
eel grass	30.0	70.0	10.0	0.0	20.0	6.0	
Eurasian watermilfoil	20.0	80.0	10.0	0.0	10.0	4.0	
slender naiad	10.0	90.0	0.0	0.0	10.0	2.0	
small pondweed	10.0	90.0	10.0	0.0	0.0	2.0	
Nitella	10.0	90.0	0.0	10.0	0.0	2.0	

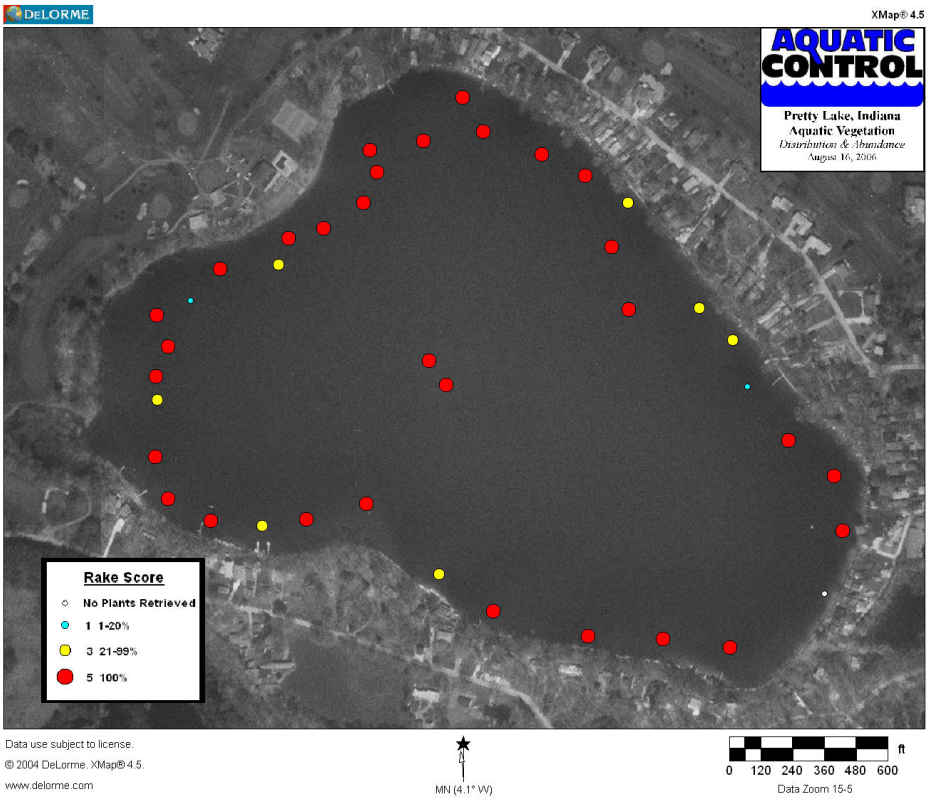

Figure 11. Pretty Lake, aquatic vegetation distribution and abundance, August 16, 2006.

Eel grass was the most frequently occurring species and ranked second in dominance. Eel grass was most abundant in waters less than 5.0 feet deep. Location and density of eel grass is illustrated in Figure 12 (in species location and density figures, plant location is illustrated by a color coded dot, the color and size of the dot represents the density of the species and sample sites without that species are illustrated by smaller white diamond). Eurasian watermilfoil was the only exotic species collected. Eurasian watermilfoil was present at the second highest percentage of sample sites (45.0%) and ranked forth in dominance (Figure 13). Eurasian watermilfoil occurred most often in waters from 5-10 feet. Illinois pondweed occurred at the same percentage of sample sites as Eurasian watermilfoil (45.0%). Illinois pondweed was abundant throughout the water column (Figure 14). Common coontail (*Ceratophyllum demersum*) was the most dominant species and occurred at 45% of sample sites. Coontail was most abundant in deeper water. Bur marigold (*Bidens beckii*), currently a state threatened species, was found at one site in Pretty Lake (Figure 15).

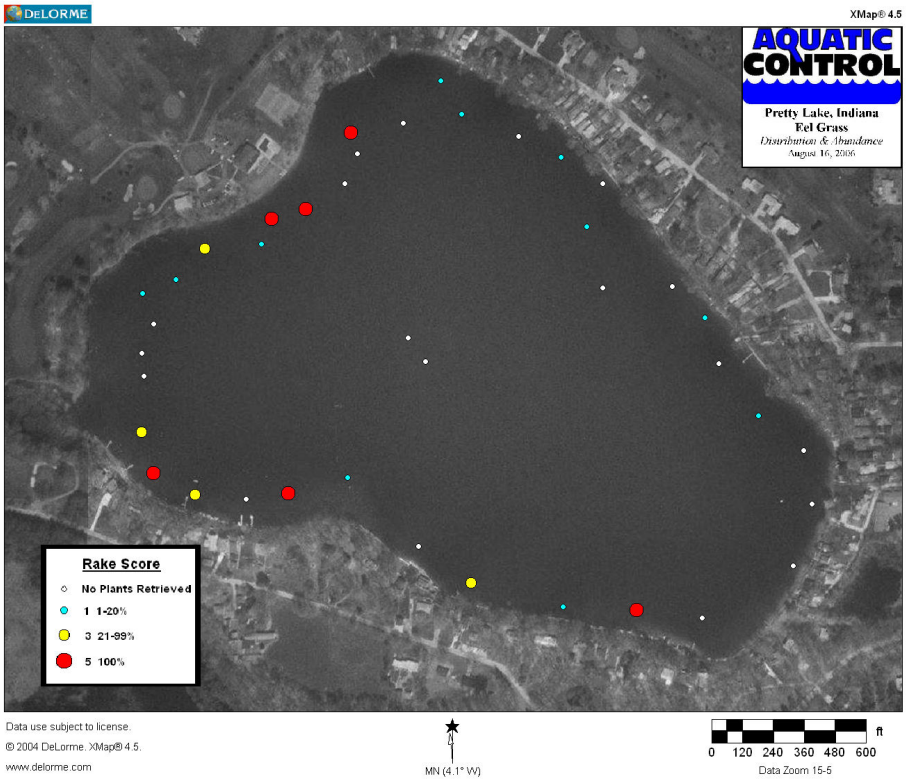

Figure 12. Pretty Lake, eel grass distribution and abundance, August 16, 2006.

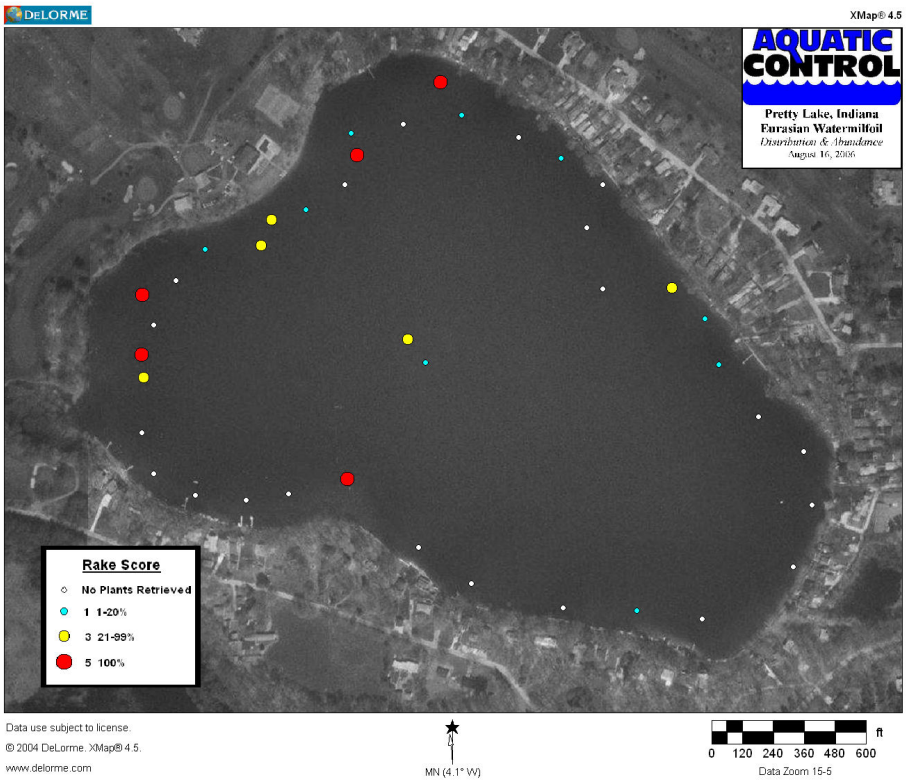

Figure 13. Pretty Lake, Eurasian watermilfoil distribution and abundance, August 16, 2006.

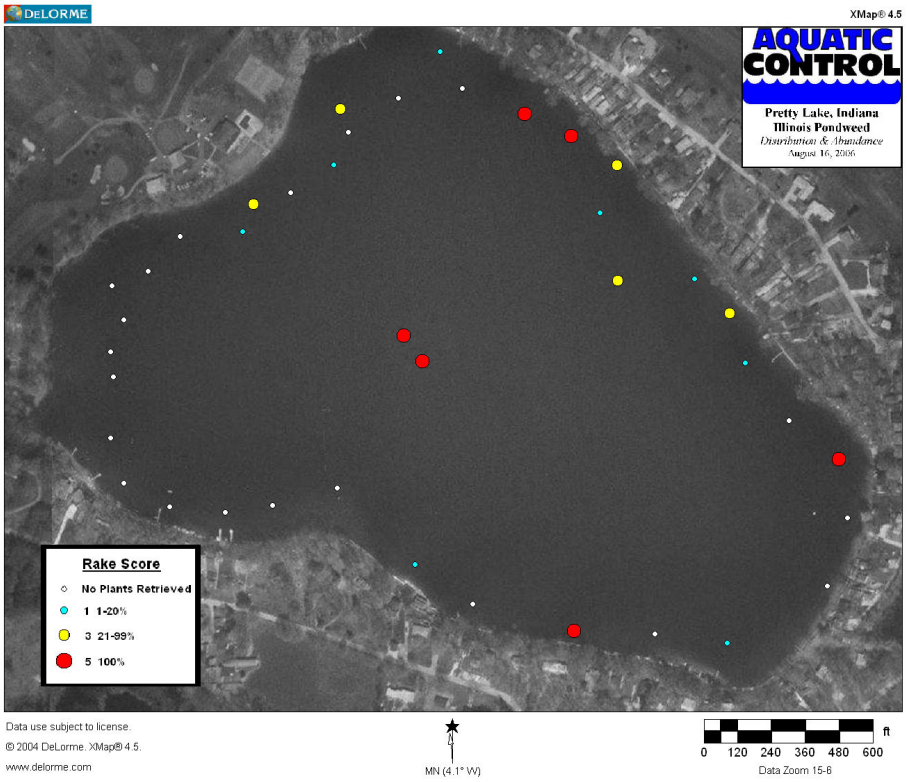

Figure 14. Pretty Lake, Illinois pondweed distribution and abundance, August 16, 2006.

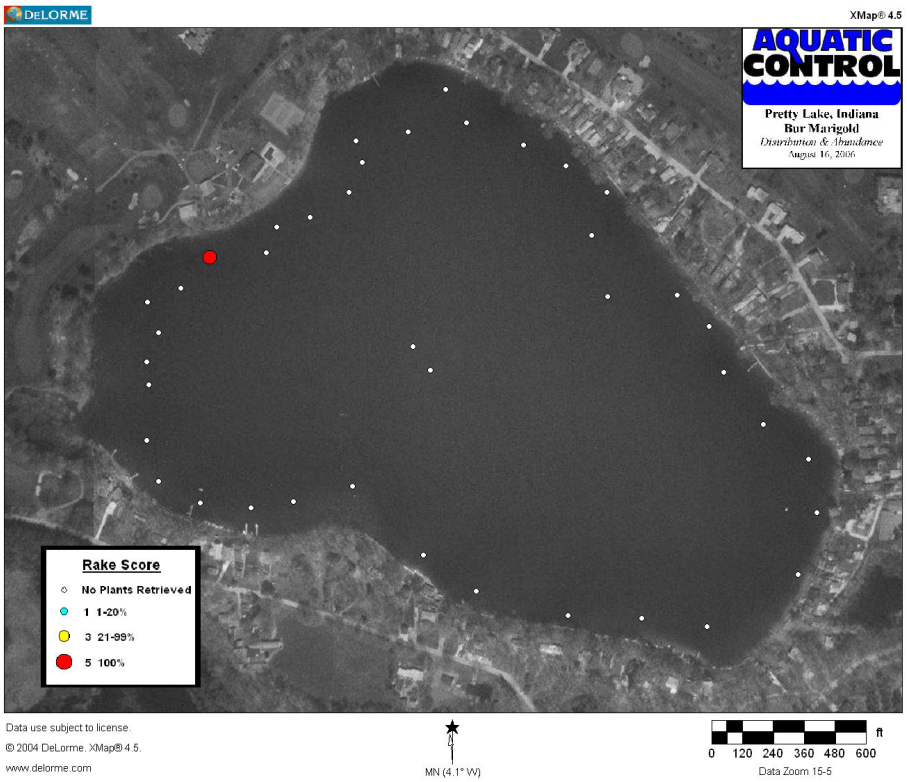

Figure 15. Pretty Lake, bur marigold distribution and abundance, August 16, 2006

8.3 Macrophyte Survey Discussion

According to Secchi measurements, Pretty Lake has good water quality compared to other Indiana lakes, and thus a relatively diverse aquatic plant community. It also appears the water clarity has increased when compared to measurements taken in 1968. Nineteen different aquatic species were documented in the Tier I and II surveys. Large beds of eel grass and largeleaf pondweed were present in shallow and deep water despite the abundance of Eurasian watermilfoil. This vegetation likely provides many benefits to the overall health of Pretty Lake and should be preserved. The developed shoreline was likely home to large beds of white water lily and spatterdock prior to settlement. Some small beds of rooted floating vegetation are now scattered along the south shore and the only large bed of rooted floating vegetation remains in the undeveloped western corner of Pretty Lake. The rooted floating vegetation has likely been removed by residents or cannot root due to the sandy substrate and wave action from high-speed boating.

The presence of Eurasian watermilfoil at such high densities is the main concern for Plant Management in Pretty Lake. This species was topped out over large areas of the lake during the spring survey and present at 45% of sample sites during the summer survey despite being targeted with contact herbicides in mid-June. In the spring Tier I survey it was estimated that 28.5 acres contained Eurasian watermilfoil and out of that 28.5 acres 24.8 acres had an abundance rating of 2 or higher. In the summer Tier I survey 28.3 acres of the littoral zone contained Eurasian watermilfoil which had an abundance rating of 2 or higher (87% of the littoral zone). As previously discussed, this species can lead to a wide variety of environmental and recreational problems. Control of this species should be a top priority to lake users.

9.0 AQUATIC PLANT MANAGEMENT ALTERNATIVES

Pretty Lake contains a diverse native aquatic plant community that is beneficial to the overall quality of the lake. However, the abundance of dense beds of Eurasian watermilfoil is a cause of concern. This species can create a variety of problems if left unchecked. Eurasian watermilfoil can negatively impact native species abundance, create nuisance conditions, and also negatively effect fish populations. Once established, growth and physiological characteristics of Eurasian watermilfoil enable it to form a surface canopy and develop into immense stands of weedy vegetation, out competing most submersed species and displacing the native plant community (Madsen et al., 1988). Many effective control techniques are available for targeting this species. Curlyleaf pondweed and purple loosestrife are also species that should be considered for control.

In order to develop a scientifically sound and effective action plan for control of nuisance vegetation, all aquatic management alternatives need to be considered. The alternatives that will be discussed include: no action; institutional; environmental manipulation; mechanical control; manual control; biological control; chemical control; and any combination of these methods.

A number of different techniques have been successfully used to control nuisance vegetation. These techniques vary in terms of their efficacy, rapidity, and selectivity, as well as the thoroughness and longevity of control they are capable of achieving. Each technique has advantages and disadvantages, depending on the circumstances. Selectivity is a particularly important characteristic of control techniques. Nearly all aquatic plant control techniques are at least somewhat selective, in that they affect some plant species more than others. Even techniques such as harvesting that have little selectivity within the areas to which they are applied can be used selectively, by choosing only certain areas in which to apply them. Selectivity can also occur after the fact, as when a technique controls all plants equally but some grow back more rapidly. One facet of selecting an appropriate aquatic plant control technique is matching the selectivity of the control technique with the goals of aquatic plant management. When controlling Eurasian watermilfoil, for example, it is typically desirable to use techniques that control Eurasian watermilfoil with minimal impact on most native species (Smith, 2002).

9.1 No Action

What if no aquatic plant management activity took place on the Pretty Lake? Past management practices have included herbicide treatments of selected shoreline areas. These treatments were successful for short-term control of nuisance species. Steps should be taken that provide longer-term control. If left unchecked, Eurasian watermilfoil would likely continue to spread and may increase in abundance and density. This increase would likely lead to a decrease in abundance of beneficial native species along with an increase in nuisance conditions.

9.2 Institutional-Protection of Beneficial Vegetation

Presence of beneficial vegetation can inhibit the growth of species which may be more prone to create nuisance conditions. For example, if a bed of largeleaf pondweed is controlled, that area will likely be quickly infested by Eurasian watermilfoil. Largeleaf pondweed rarely reaches the surface and if it does, it typically does not develop the density of a milfoil bed. Dense milfoil beds are impossible to boat across, difficult to fish, and provide poor habitat. On the other hand, largeleaf pondweed rarely reaches the density of Eurasian watermilfoil and provides excellent habitat for fish and aquatic invertebrates. Many associations attempt to control all vegetation. This can create a competitive advantage for aggressive species like Eurasian milfoil which can quickly colonize a controlled area. Protection of beneficial vegetation should be part of any vegetation management plan.

9.3 Environmental Manipulation

9.3.1 Water Level Manipulation

Water level manipulation refers to the raising of water levels to control aquatic vegetation by drowning or lowering to control aquatic vegetation by exposing them to freezing, drying or heat. Use of water level manipulation for aquatic plant management is limited

to lake and reservoirs with adequate water control structures. Pretty Lake does not have adequate water control structures, so this technique should not be considered.

9.3.2 Nutrient Reduction

Plant growth can be limited if at least one nutrient, which is critical for growth, is in short supply. Nitrogen, phosphorus or carbon are usually the nutrients limiting plant growth in lakes. Therefore, if at least one of these nutrients can be limited sufficiently so that plants do not grow to a nuisance level, this nutrient limitation can be used as a method of aquatic plant management. Generally, however, plants in northern Indiana can obtain the majority of necessary nutrients from the soil. Reduction of nutrients can actually aggravate an existing problems by increasing light penetration leading to an expansion in plant growth (Hoyer & Canfield, 1997). However, in certain situations, nutrient reduction can be effective at controlling overabundant floating vegetation or microscopic algae blooms. It appears that Pretty Lake has relatively low nutrient levels, but Eurasian watermilfoil is present at high levels and creates nuisance conditions.

9.4 Mechanical Control-Harvesting, Cutting, Dredging

Mechanical control includes cutting and/or harvesting of aquatic vegetation or dredging the bottom sediments to eliminate aquatic plant growth. The main advantage to mechanical control is the immediate removal of the plant growth from control areas and the removal of organic matter and nutrients.

One of the most common mechanical control techniques used on larger lakes in Indiana is mechanical harvesting. Mechanical harvesting uses machines which cut plant stems and, in most cases, pick up the cut fragments for disposal. This type of mechanical control has little selectivity. Where a mix of Eurasian watermilfoil and native species exists, harvesting favors the plant species that grow back most rapidly following harvesting. In most cases, Eurasian watermilfoil recovers from harvesting much more rapidly than native plants. Thus, repeated harvesting hastens the replacement of native species by Eurasian watermilfoil and often leads to dense monocultures of Eurasian watermilfoil in frequently harvested areas. Harvesting also stirs up bottom sediments thus reducing water clarity, kills fish and many invertebrates, and hastens the spread of Eurasian watermilfoil via fragmentation.

Dredging of shallow areas may reduce nuisance conditions caused by vegetation in the short-term, but studies and personal experience have shown that Eurasian watermilfoil is often the first species to colonize these disturbed areas. Dredging is expensive, especially if a nearby disposal sight is not available. Careful consideration to secondary environmental effects must be considered and permits from regulatory agencies are usually necessary before conducting dredging operations. Dredging is usually short lived if not done deeper than the photic zone.

9.5 Manual Control-Hand Pulling, Cutting, Raking

Removal of small amounts of vegetation by hand, which interfere with beach areas or boat docks, may be the only vegetation control necessary in some areas. Of course, hand removal is labor intensive and must be conducted on a routine basis. The frequency and practicality of continued hand removal will depend on availability of labor, regrowth or reintroduction potential of the vegetation, and the level of control desired (Hoyer & Canfield, 1997). Residents of Pretty Lake have the option to harvest areas of submersed vegetation in and around their docks or swimming areas. Residents should keep in mind that only a 625 square foot area can be harvested without obtaining a permit from IDNR.

9.6 Biological Controls

Biological controls reduce aquatic vegetation using other organisms that consume aquatic plants or cause them to become diseased. The main biological controls for nuisance vegetation used in Indiana are the grass carp, milfoil weevil, and a variety of insects which prey upon purple loosestrife. These controls would require a permit from IDNR.

9.6.1 Grass Carp

The grass carp (*Ctenopharyngodon idella)* is an herbivorous fish imported from Asia. Triploid grass carp, the sterile genetic derivative of the diploid grass carp, are legal for use in Indiana. Grass carp tend to produce all or nothing aquatic plant control. It is very difficult to achieve a stocking rate sufficient to selectively control nuisance species without eliminating all submersed vegetation. They are not particularly appropriate for Eurasian watermilfoil control because this species is low on their feeding preference list; thus, they eat most native plants before consuming Eurasian watermilfoil (Smith, 2002). Grass carp are also difficult to remove from a lake once they have been stocked and are also illegal to stock into Indiana natural lakes. Grass carp are not recommended for nuisance vegetation control in the Pretty Lake.

9.6.2 Milfoil Weevil

The milfoil weevil, *Euhrychiopsis lecontei,* is a native North American insect that consumes Eurasian and Northern watermilfoil. The weevil was discovered following a natural decline of Eurasian watermilfoil in Brownington Pond, Vermont (Creed and Sheldon, 1993), and has apparently caused declines in several other water bodies. Weevil larvae burrow in the stem of Eurasian watermilfoil and consume the vascular tissue thus interrupting the flow of sugars and other materials between the upper and lower parts of the plant. Holes where the larvae burrow into and out of the stem allow disease organisms a foothold in the plants and allow gases to escape from the stem, causing the plants to lose buoyancy and sink (Creed et al. 1992).

Concerns about the use of the weevil as a biological control agent relate to whether introductions of the milfoil weevil will reliably produce reductions in Eurasian watermilfoil and whether the resulting reductions will be sufficient to satisfy users of the lake (Smith, 2002). Following our research, no conclusive data concerning the role of weevils in reducing Eurasian watermilfoil populations has been made available. In 2003,

Scribailo and Alix conducted a weevil release study on three Indiana lakes and had no conclusive evidence supporting the use of weevils in reducing milfoil populations. Weevils may reduce milfoil populations in some lakes, but predicting which lakes and how much, if any, control will be achieved has not been documented (Scribailo & Alix, 2003).

9.6.3 Purple Loosestrife Insects (Summarized from JFNew & Associates, 2005)
Some control of purple loosestrife has been achieved through the use of several insects. A pilot project in Ontario, Canada reported a decrease in 95% of the purple loosestrife population from pretreatment population (Cornell Cooperative Extension, 1996 cited in JFNew, 2005). Four different insects were used to achieve this control. These insects have been identified as natural predators of purple loosestrife in its native habitat. Insect releases in Indiana to date have had mixed results. After six years, the loosestrife of Fish Lake in LaPorte County is showing signs of deterioration. Likewise, seven years after the release at Pleasant Lake in St. Joseph County, purple loosestrife populations appear to have declined around the boat ramp (IDNR, 2004 cited in JFNew, 2005). Biological control is not a quick solution; many estimates suggest that it may take 5-15 years to achieve a large impact on purple loosestrife populations.

9.7 Chemical Control
Chemical control uses chemical herbicides to reduce or eliminate aquatic plant growth. The main disadvantage to the use of chemicals is the publics concern over safety. Extensive testing is required of aquatic herbicides to ensure that the herbicides are low in toxicity to human and animal life and they are not overly persistent or bioaccumulated in fish or other organisms. It often takes several decades of testing by the Environmental Protection Agency (E.P.A.) before a herbicide is approved for aquatic use. After E.P.A approval and registration, the herbicide must go through the registration process in each state.

Another disadvantage to the use of aquatic herbicides is water use restrictions. These restrictions must be posted prior to treatment on a public body of water. The most common restriction is irrigation. Another disadvantage to the use of herbicides is the release of nutrients that can occur if large areas of vegetation are controlled. This can be avoided by early application that controls vegetation before it reaches its maximum biomass. These perceived disadvantages are often times out-weighed by this technique's proven rapid effectiveness and selectivity.

There are two different types of aquatic herbicides, systemic and contact. Systemic herbicides are translocated throughout the plants and thereby kill the entire plants. Fluridone (trade name Sonar & Avast!), 2,4-D (trade name Navigate, Aqua-Kleen, & DMA4 IVM), and triclopyr (trade name Renovate) are systemic herbicides that can

effectively control Eurasian watermilfoil. Triclopyr, imazapyr, and glyphosate are systemic herbicides that can control purple loosestrife.

Based upon the author's experience and personal communication with an array of North American aquatic plant managers, whole-lake fluridone applications are by far the most effective means of controlling Eurasian watermilfoil. Successful fluridone treatments yield a dramatic reduction in the abundance of Eurasian watermilfoil, often reducing it to the point that Eurasian watermilfoil plants are difficult to detect following treatment (Smith, 2002). An advantage to using fluridone over most contact herbicides is its selectivity. Most strains of Eurasian watermilfoil have a lower tolerance to fluridone than the majority of native species, so if the proper rates are applied Eurasian watermilfoil can be controlled with little harm to the majority of native species. Another advantage of a fluridone treatment is the limited water-use restrictions. Irrigation is the only restriction that would apply to Pretty Lake. Irrigation of turf grass can take place at typical Eurasian watermilfoil treatment rates (<10ppb).

Aquatic Control has completed whole lake fluridone treatments on two public natural lakes in Indiana. Webster Lake was treated in 1999 and 2002. Eurasian watermilfoil was not detectable in the late summer the year of treatment or the year following treatment. Re-infestation of Eurasian watermilfoil occurred within three years, but that was likely due to presence of milfoil in the immediate watershed (lakes that contained Eurasian watermilfoil in the immediate watershed were not permitted for treatment). Wolf Lake, a 451-acre lake in northwest corner of Indiana, was treated with fluridone in 2004 and no Eurasian watermilfoil has been detected since the treatment. The long-term success of a fluridone treatment is variable from lake to lake. Since milfoil can spread by fragmentation, success of the treatment is dependent on eliminating all of the plants from the watershed. Pretty Lake is a perfect candidate for a whole lake treatment since it has a very small watershed with little outflow.

Triclopyr is a systemic herbicide that has recently been approved for use in aquatics. Triclopyr typically is used for treating isolated milfoil beds as opposed to whole lake treatments. This herbicide is very selective to Eurasian watermilfoil. A study was conducted in 1997 during the registration process of this herbicide. The study found Eurasian watermilfoil biomass was reduced by 99% in treated areas at 4 weeks post-treatment, remained low one year later, and was still at acceptable levels of control at two years post-treatment. Non-target native plant biomass increased 500-1000% by one year post-treatment, and remained significantly higher in the cove plot at two years post-treatment. Native species diversity doubled following herbicide treatment, and the restoration of the community delayed the re-establishment and dominance of Eurasian watermilfoil for three growing seasons (Getsinger et. al., 1997). Triclopyr is a good alternative to fluridone when Eurasian watermilfoil is not abundant throughout an entire water body. It is difficult to completely eliminate Eurasian watermilfoil with this type of herbicide, but an aggressive treatment program would significantly reduce milfoil density and abundance to a more manageable level. Eurasian watermilfoil must be treated everywhere it is located in the lake. The only water use restriction following a triclopyr treatment is irrigation (there are also restrictions associated with drinking water, but those

restrictions do not apply in this situation). An assay is needed to monitor the concentration in the water before irrigation can take place. One of the drawbacks to using triclopyr has been the fact that only a liquid formulation has been available. This can dramatically increase costs for treatment in deep water areas. In 2007, a granular formulation called Renovate OTF has been approved for aquatic use in Indiana. This should help with control of Eurasian watermilfoil in deep water treatments.

Applied properly, 2,4-D can also yield major reductions in the abundance of Eurasian watermilfoil. Much like triclopyr, treatments must be even and dose rates accurate. This formulation should be used much like Triclopyr. Unlike Triclopyr, 2,4-D can impact the native species coontail. This herbicide can be applied for less cost than triclopyr, but damage will likely occur to coontail. 2,4-D herbicide should be considered as an alternative to triclopyr applications if the Association's budget is restricted. 2,4-D is also available in liquid and granular formulations.

Contact herbicides can also be effective for controlling submersed vegetation in the short term. The three primary contact herbicides used for control of submersed vegetation are diquat (trade name Reward), endothal (trade name Aquathol), and copper based formulations (trade names Komeen, Nautique, and Clearigate).

Historically, a drawback to the use of contact herbicides has been the lack of selectivity exhibited by these herbicides. However, a study completed by Skogerboe and Getsinger in 2002 outlines how endothal can be used for control of the exotic species curlyleaf pondweed and Eurasian watermilfoil with little effect on the majority of native species. They found early season treatments with endothall effectively controlled Eurasian watermilfoil and curlyleaf pondweed at several application rates with no regrowth eight weeks after treatment. Sago pondweed, eel grass, and Illinois pondweed biomass were also significantly reduced following the endothall application, but regrowth was observed at eight weeks post-treatment. Coontail and elodea showed no effects from endothall at three of the lower application rates. Spatterdock, pickerelweed, cattail, and smartweed were not injured at any of the application rates (Skogerboe & Getsinger 2002). This type of treatment strategy could be applied to lakes that have large areas of both curlyleaf pondweed and Eurasian watermilfoil. Endothal could also be effective the year after whole lake sonar treatments where curlyleaf pondweed typically returns the following season.

Diquat and many of the copper formulations are effective fast acting contact herbicides. These formulations are typically used when control of all submersed vegetation is desired. These herbicides are commonly used for control of nuisance vegetation around docks and near-shore high-use areas. Diquat and the copper based herbicides are not as selective as many of the other herbicides and plants can often times recover in 4-8 weeks after treatment. There are no water use restrictions following the use of chelated copper based herbicide, which makes them popular choices for lakes used for irrigation or drinking water.

10.0 PUBLIC INVOLVEMENT

An effective aquatic vegetation management plan must include input from lake users. A public meeting was conducted on September 20, 2006 at the Plymouth Country Club on the shores of Pretty Lake. The meeting was advertised in the local newspaper. Approximately twenty-five individuals attended the meeting.

The goals of the meeting were as follows:

1. Inform lake users of the planning process
2. Document important high-use areas of the lake
3. Educate those in attendance on aquatic plant ecology
4. Describe results of the plant sampling
5. Discuss plant management alternatives
6. Discuss implementation of the potential management strategies and monitoring programs
7. Obtain user input by filling out a survey (see appendix for survey form)

According to surveys forms, everyone in attendance lived on the lake and were members of the association. Eighty percent of those surveyed had lived on the lake for 10 or more years. One-hundred percent of those surveyed used the lake for boating and swimming, 85% for fishing, and 10% used the lake for irrigation. On survey questions concerning lake problems; 60% believed there were too many aquatic plants, 15% thought dredging was needed, 10% believed there were too many boats with access, none of those surveyed believed there were not enough plants, none thought there was a fish population problem, none believed there was a water quality problem, and none believed that too many jet ski's were a problem (jet skis are discouraged on Pretty Lake by a sign at the only access site informing lake users that "Jet Skis Are Not Welcome"). On survey questions dealing with aquatic vegetation; 55% believed vegetation interfered with lake use, 40% believed it affected property value, 75% believed vegetation was at a nuisance level, and 100% were in favor of continuing vegetation control efforts.

Following the vegetation management plan presentation, Gwen White, a LARE biologist from IDNR, presented information concerning watershed management. She also discussed the steps that need to be taken in order to receive traditional LARE funding for completion of a Diagnostic Study.

11.0 PUBLIC EDUCATION

In order to effectively manage aquatic vegetation lake users must gain an understanding of the ecology of the lake ecosystem and the effects individual actions may have on this resource. The Pretty Lake Association should be commended on heading up a project to install sewer systems around the lake. However, there is very little data on the watershed or historical water quality of Pretty Lake. It is recommended that the Association apply for grants for completion of a Diagnostic Study. On a smaller scale, steps can be taken by individual property owners that will also help preserve and enhance Pretty Lake. The following is a list of potential actions that individuals can undertake:

1. Reduce the frequency and amount of fertilizer, herbicide, or pesticide used for lawn care.

2. Use only phosphorus-free fertilizer.
3. Consider re-landscaping lawn edges, particularly those along the watershed's lakes, to include low profile prairie species that are capable of filtering runoff water better than turf grass
4. Consider resurfacing concrete or wooden seawalls with glacial stone, then planting native emergent vegetation along shorelines or in front of resurfaced or existing concrete or wooden seawalls to provide fish and invertebrate habitat and dampen wave energy.
5. Keep organic debris like lawn clipping, leaves, and animal waste out of the water
6. Properly maintain septic systems. Systems should be pumped regularly and leach fields should be properly cared for.
7. Examine all drains that lead from roads, driveways, and rooftops to the watershed
8. Obey speed limits through the lakes
9. Thoroughly clean all material from boats and trailers after lake use and refrain from dumping bait buckets into the lake to prevent the spread of exotic species (JFNew, 2005).

These points should be reinforced annually at Association meetings and in newsletters or on websites.

12.0 INTEGRATED MANAGEMENT ACTION STRATEGY

The focus of the action strategy should be designed to meet the goals and objectives of the aquatic plant management plan. To review, the goals are as follows:

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and fish and wildlife resources.

Each goal, along with objectives to meet this goal, is listed below. Following each objective are the actions which should be taken in order to achieve the objective.

12.1 Goal #1-Maintain Stable and Diverse Native Population

The first goal focuses on developing or maintaining a stable, diverse aquatic plant community. In order to address the objectives for meeting this goal the plant community will be divided into two categories: emergent/floating vegetation and submersed vegetation. The focus of the LARE program is primarily on control of nuisance exotic submersed vegetation, but seeing how this is an aquatic vegetation management plan one cannot ignore the emergent and rooted floating plant community.

Objective 1: Maintain and Enhance Diversity of the Rooted Floating/Emergent Aquatic Plant Community

There is only one large area of rooted floating and emergent vegetation remaining in Pretty Lake. This area is located in the southwest corner of the lake just south of the clubhouse. This community serves several beneficial purposes to Pretty Lake that includes reducing erosion, providing fish and wildlife food and habitat, and filtering excessive nutrients. This plant community should be protected from development. The majority of Pretty Lake's shoreline is developed and much of the shoreline is lined with seawalls. Seawalls are somewhat effective at reducing erosion, but they also eliminate a very ecologically important area of the lakes ecosystem and increase wave action in the lake. New developments should consider natural shorelines that allow emergent and rooted floating vegetation to grow. A dense shallow water plant community should help reduce erosion, prevent geese from entering and exiting the lake, provide cover for fish and wildlife, and help filter nutrients that may enter the lake from developed sites. If erosion is still a problem, glacial stone is the recommended as a replacement for rip-rap or concrete. Figure 16 is an example of a developed shoreline on Crooked Lake in Steuben County. This home site has allowed native vegetation to flourish along their shoreline yet still has good lake access.

Figure 16. Crooked Lake, emergent plant community along developed shoreline, June 2006.

As documented, purple loosestrife is present at low levels within the remaining emergent plant beds surrounding Pretty Lake. This plant has the potential to spread and displace beneficial native species. The LARE program has yet to fund control of this plant, so it is important that residents take action in securing funds from other sources and conduct their own controls. Residents should become familiar with this species and dig it up if it is found on their property. Biological controls show a lot of promise and are less

expensive and controversial than herbicide applications (there are a lot of issues with applying herbicides on private property as opposed to treating the water which is public property). The association should stay abreast of any funding or studies being completed with these biological controls and make all attempts to secure funds.

Objective 2: Maintain density and diversity of submersed vegetation.
Pretty Lake has a relatively good density and diversity of submersed vegetation. This vegetation provides fish cover, filters nutrients, and is vital to the overall ecology of Pretty Lake. Many beneficial pondweeds and even some rare species are present within the littoral zone. Lake users need to be educated on the benefits of this vegetation. Native vegetation should only be controlled where it is obviously negatively impacting lake use. Residents should keep in mind that few native plants around a dock area do not negatively impact lake use. If boats cannot easily get through native plant beds, then control could be initiated. Reduction in Eurasian watermilfoil should also reduce competition with native vegetation. Once the milfoil is controlled native plants should increase in abundance.

12.2 Goal #2-Reduce Negative Impacts Caused by Exotic Vegetation
The second goal of the vegetation management plan is to prevent and reduce negative impacts of aquatic invasive species. Goal one and two are somewhat related because one of the negative impacts of invasive species is their tendency to displace beneficial native vegetation.

Objective 1: Reduce and Control Eurasian watermilfoil density and abundance
One of the main invasive species of concern is Eurasian watermilfoil. Eurasian watermilfoil had an abundance rating of 2 or higher in 24.5 acres of the littoral zone during the spring Tier I survey and an abundance rating of 2 or higher in 28.3 acres of the littoral zone in the summer survey (this accounts for over 80% of the littoral zone of Pretty Lake). This species was also present at 45% of sample sites during the summer Tier II survey. Eurasian watermilfoil reproduces through fragmentation and can rapidly reach nuisance levels. This makes it of special concern when it comes to aquatic plant management. This species can also displace native vegetation due to this rapid growth and its tendency to form a canopy shading out native species. This species has been one of the main targets of control with contact herbicides. These treatments have been effective in the short term, but milfoil can return within a few months when treated with contact herbicides. In addition, when contact herbicides are used to control milfoil there is likely damage to the native plant community.

Whole lake fluridone treatments have historically been the best method for long-term control of Eurasian watermilfoil. This technique is ideal for Pretty Lake since it has very little flow (fluridone must stay at a certain concentration for a long period of time, so outflow can dramatically increase the difficulty and cost of treatment). Another option that must be considered for milfoil control would be to complete spot treatments with either 2,4-D or Renovate herbicide. Up to 28 acres of milfoil would likely require treatment. The cost of this treatment would be between $10,000-$12,000 for the initial

treatment. This treatment may have to be repeated for several years in order to obtain long-term control (there would likely be less every year, but it is hard to predict the exact amount with this type of treatment strategy). The long-term cost of completing spot treatments would likely be more than completing a whole lake fluridone treatment.

A whole lake treatment with fluridone is clearly the best method for this particular lake. The fluridone treatment should be completed with a goal of achieving an initial 6 ppb concentration and keeping this concentration above 3 ppb for 90 days. FasTests should be collected from two locations 3 days after treatment in order assess the initial fluridone concentration. Additional treatments should be completed if a 6 ppb concentration has not been achieved. Once tests indicate that 6ppb has been reached testing should take place every three weeks for 90 days. Two tests should be taken from two different sections of Pretty Lake. If the tests indicate that the concentration is below 4 ppb, a bump treatment should be completed with enough fluridone to bring it back to 6 ppb. The treatment should be started in early May of 2007. One species that will be damaged with this treatment is bur-marigold (this species has near the same low tolerance to fluridone as Eurasian watermilfoil). Bur marigold is currently being propagated at the SePRO Research and Technology Campus in North Carolina for replacement in a New York lake following a whole lake treatment. Dr. Tyler Koschnick, a research biologist for SePRO, has agreed to work with Aquatic Control Inc. in order to help propagate bur marigold at the Aquatic Control research facility. He has also agreed to send any plants that he has left over from the New York planting if our propagation efforts fail. Bur Marigold plants should be collected prior to treatment. These should be grown in a controlled environment and planted back into Pretty Lake in the spring of 2008.

Along with chemical control, it will be important for lake users to do their part in controlling Eurasian watermilfoil. Eurasian watermilfoil spreads through fragmentation, so it is easy to introduce this species to new areas. It is important that boaters avoid driving through any milfoil beds. This can chop up the plants causing them to float into new areas. It is also important that boaters check their props and trailers when traveling from lake to lake removing any plant fragments. One fragment of milfoil can lead to an entire colony. Signs should also be placed at all access points warning boaters to check for plant fragments. This is especially important since the discovery of hydrilla (*Hydrilla verticillata)* in Lake Manitou.

Objective 2: Prevent further spread of Purple Loosestrife
As mentioned when discussing goal number one, purple loosestrife can be detrimental to native wetland species. Control of this species may be funded by LARE depending on availability and prioritization of funds. If this species is discovered on one's property, it will be important to individual homeowners to dig up and remove the entire plant. An illustration of this species was included in Figure 5 located on page 6 of this plan.

Objective 3: Monitor curlyleaf pondweed and control if necessary
The exotic species, curlyleaf pondweed is common to northern Indiana lakes, and was found during surveys of Pretty Lake. Historically, control of this species has not been funded by the LARE program due to its tendency to senesce during the busy summer season. After Eurasian watermilfoil is under control it may become economically

feasible to begin controlling curlyleaf pondweed. This species will likely be the primary nuisance species in the spring of 2008 if Eurasian watermilfoil controls are initiated. Control of this species will require multiple seasons of treatment due to the presence of curlyleaf pondweed turions, which may last several seasons after treatment. Low dose endothal treatments are effective for selective control of curlyleaf pondweed.

Objective 4: *Create public awareness of the potential for hydrilla invasion and post signs for cleaning off boats at all private and public access sites*
Hydrilla, an extremely aggressive submersed aquatic plant species, has been recently discovered in Lake Manitou, which is located in north central, Indiana. This species can be easily confused with native elodea. The main difference in the species is the presence of 3 leaves per whorl on native elodea compared to 5 leaves per whorl on hydrilla. Hydrilla also has visible teeth along the leaf margins. Currently, it is believed that this plant is isolated in the Lake Manitou area, but much like Eurasian watermilfoil, this species has the ability to reproduce by fragmentation. This allows it to be spread easily from lake to lake. It is very important that lake users understand the importance of thoroughly cleaning off their boats when entering and exiting Pretty Lake. Posting signs at the ramp will help reinforce this point. Warnings about this plant should also be sent to members of the Association. An illustration of hydrilla follows in Figure 17.

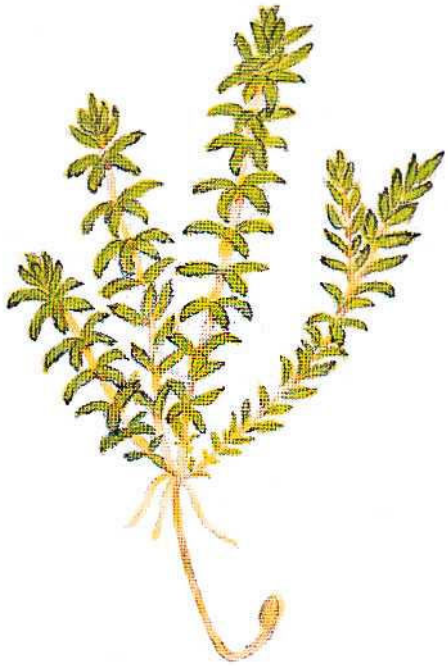

Figure 17. Illustration of hydrilla (Illustration provided by Applied Biochemist).

12.3 Goal #3: Provide Reasonable Recreational Access While Minimizing the Negative Impacts on Plant, Fish, and Wildlife Resources

The focus of plant control should be on nuisance exotic species, but even if all exotic species were eliminated it will be necessary to control some native plants in order to provide access to docks and high-use areas. This will require control of some native vegetation.

Objective 1: Control vegetation around docks and the boat ramp in order to allow for boat access

If left unchecked, some homeowners would be locked into their dock areas by native vegetation. Some homeowners may have the ability to physically remove the vegetation from these areas (625 square feet can be removed without a permit). It is recommended that if possible, homeowner's control the 625 square feet. However, some areas may be too dense or some homeowners may not be capable of completing this task. In this case it will be necessary to contact professionals to complete the work. Applied properly, aquatic herbicides are typically the best method for control of dense vegetation growth. Treatment should be limited to near shore high-use areas. Width of shoreline treatments should not exceed 100 feet out from shore. Treatment of rooted floating vegetation should be limited to a wide enough area for boats to pass (20-30 feet). It has also been IDNR's policy to only permit treatment of native vegetation in half of the shoreline areas of any given lake in order to avoid loss of oxygen and increased nuisance algae blooms.

12.4 List of Actions To Be Initiated

The purpose of the LARE grant was to fund aquatic vegetation control on public lakes. Listed below, in order of importance, are recommended actions in order to meet the goals and objectives of the aquatic vegetation management plan. Some of these actions may be funded by LARE, but many will require funds from the Association.

1. Initiate treatment of Pretty Lake with fluridone herbicide. Treatment should take place in the spring of 2007. Treatment should include an initial low dose in order to compensate for the lack of volumetric data. Tests should be completed within 4 days of initial treatment in order to assess the need for a bump application. Initial concentration should be 6ppb and maintained above 3 ppb for 90 days. Testing should take place every 3 weeks after 6 ppb is reached. If concentration drops to 4 ppb a bump treatment should be completed in order to get concentration back to 6 ppb. Prior to treatment, bur marigold should be harvested and grown in a controlled environment. In 2008 bur marigold should be planted back into Pretty Lake in the general location where it was harvested.
2. Monitor plant community with plant surveys for next five years in order to assess the effectiveness of controls and response of native plant community. Plant surveys will also be invaluable to quickly detect and control potential reinfestation of Eurasian watermilfoil. In 2007, surveys should consist of a summer Tier II survey in 2007. A treatment map survey should be completed in the spring of 2008 along with a summer Tier II survey. These surveys should be continued through 2011.
3. Post signs at <u>all access sites</u> in warning boaters of the potential for invasive plant species introductions from boat trailers. Signs should implore boaters to clean trailers, props, and boats of all vegetation fragments when entering and leaving Pretty Lake. Information concerning the potential spread of Eurasian watermilfoil and hydrilla should be distributed to all Association members and lake users.
4. Secure funding for completion of a diagnostic study on Pretty Lake.

5. Remove purple loosestrife from individuals' property and pursue funding source to biological controls.
6. Maintain dock areas with physical plant removal when possible or by contracting professional applicators. Treatments should not exceed 100 feet from shoreline for submersed vegetation and treatment of rooted floating vegetation should be limited to boating lanes.
7. Educate lake users on best management practices in order to improve water quality.
8. Monitor curlyleaf pondweed population and consider control after Eurasian watermilfoil is reduced.

13.0 PROJECT BUDGET

Table 4 is an estimated budget for the aquatic vegetation management action plan. The majority of the cost will be for initial whole lake treatment of Eurasian watermilfoil and various requirements associated to this treatment (testing, harvesting of Bur Marigold, and replanting). It is estimated that very little milfoil will return within the next five years if the treatment is done correctly, but plant sampling should take place in order to detect and treat any possible reinfestation. The year of treatment, plant sampling should consist of a Tier II survey in late summer. In following seasons, sampling should consist of a treatment map survey in the spring to detect any milfoil reinfestation along with a Tier II survey in the summer. It is proposed that IDNR fund treatment of milfoil and plant survey updates (this will require a 10% match from the Association). **It is our recommendation that the Pretty Lake Association requests $27,000 for a whole lake fluridone treatment to be completed in 2007. This cost includes all necessary testing. The Association should also request $1,500 for harvest and growing of bur marigold. In addition, $4,000 should be requested for plant sampling and plan updates.** Curlyleaf pondweed should also be monitored in years following the whole lake treatment. This species may require future control. A permit has been created for this treatment and is included in the Appendix. This permit should be handled by the association and once a contractor is selected for the treatment the permit can be completed. It is possible that this project may not be fully funded due to a recent hydrilla infestation in Lake Manitou that may use a large percentage of potential LARE funds.

Table 5. Budget estimate for the action plan (native treatments not included in budget since they are funded by individual lot owners).

	2007	2008	2009	2010	2011
Whole Lake fluridone Treatment of Eurasian watermilfoil	$27,000	-	-	-	-
Bur Marigold Harvest and Re-introduction	$1,500	$1,500	-	-	-
Potential spot treatment of any detected Eurasian watermilfoil with 2,4-D or Renovate OTF	-	-	-	$2,000	$2,000
Plant sampling and plan updates (potential LARE funding with 10% match)	$4,000	$4,000	$4,000	$4,000	$4,000
Total:	**$32,500**	**$5,500**	**$4,000**	**$6,000**	**$6,000**

*Request $32,500 from LARE program in 2006.

There may still be a need for some shoreline spot treatments for control of native funded by individual lot owners. IDNR limits the amount of treatment to less than half of the shoreline. If more than half of the residents request treatment, it will be up to the Association and their plant manager to decide on what areas are most impaired by nuisance vegetation. It is unlikely that more than half of the shoreline would require treatment.

14.0 MONITORING AND PLAN UPDATE PROCEDURES

One of the most important actions in the aquatic vegetation management plan is the continued monitoring of the plant population. Continued monitoring will provide valuable data to the aquatic plant manager. This data can be used to complete the following tasks: allow for needed changes to be made to the plan; monitor success or failure of controls; monitor improvements or damage to native plants; and detect potential new invasive species at an early stage of infestation. In 2007, monitoring should consist of a Tier II survey in July or August. The Tier II survey provides managers with quantitative data that can point out trends in the plant community. In 2008, and following years a treatment map survey should be conducted in the spring in an effort to detect any potential Eurasian watermilfoil reinfestation. A Tier II survey should be conducted in the in July or August of the following years. Each winter this data should be analyzed and included in an update to the aquatic vegetation management plan. The surveys may lead to changes in the recommended actions of the plan.

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16.0 APPENDICIES

16.1 Data Sheets

Tier 1

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization: Aquatic Control

Waterbody Name: Pretty Lake Lake ID:

County: Marshal Date: 6-6-6

Habitat Stratum: IL Ave. Lake Depth (ft): 20 Lake Level: Normal

Crew Leader: N. Long

GPS Metadata

Datum: Nad27 Zone: 3M Accuracy: 16

Recorder: K. McCreary Method: D

Secchi Depth (ft): 14.0 Total # of Plant Beds Surveyed: 8 Total # of Species: 17

Littoral Zone Size (acres): 30.8

- [x] Measured
- [ ] Estimated

Littoral Zone Max. Depth (ft): 23.0

- [x] Measured
- [ ] Estimate (historical Secchi)
- [ ] Estimated (current Secchi)

Notable Conditions:

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 3

State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 6-6-06

SITE INFORMATION

Plant Bed ID: 01
Bed Size: 11.8
Substrate: 03
Marl? 0
High Organic? 0

Waterbody Name: Pretty Lake
Waterbody ID:
Total # of Species 14

CanopyAbundance at Site

S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

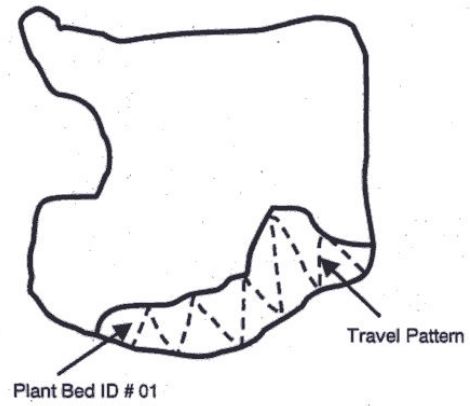
Center of the Bed
Latitude: N41.32491
Longitude: W 86.36873

Max. Lakeward Extent of Bed
Latitude: N41.32461
Longitude: W86.37104

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POAM	2	0	0	
PORI	2	0	0	
POIL	1	1	1	
POPU	1	0	0	
MYSPI	2	0	0	
CHARA	1	2	0	
CEDE4	2	0	0	
NYTU	1	0	0	
NAFL	1	1	0	
POFO	1	0	0	
MYHE	1	1	0	
POCR3	2	0	0	
VAAM3	1	0	0	
MyHE	1	1	0	

Individual Plant Bed Survey



Comments:

Secchi: 14ft
Max Plant Depth 23Ft
M. Infoil & Coon

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of 8

State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 6-6-06

SITE INFORMATION

Plant Bed ID: 02
Bed Size: 2.1
Substrate: 6
Marl? 0
High Organic? 0

Waterbody Name: Pretty Lake
Waterbody ID:
Total # of Species 3

CanopyAbundance at Site

S: M 01 N: M 01 F: M 01 E: C 01

SITE COORDINATES

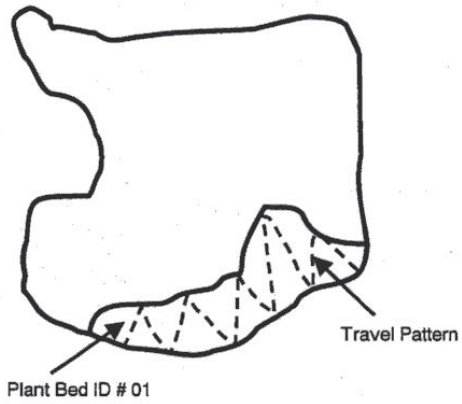
Center of the Bed
Latitude: N41.32557
Longitude: W86.36864

Max. Lakeward Extent of Bed
Latitude: N41.32570
Longitude: W86.36913

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
CHARA	2	2	0	
POR1	1	0	0	
VAMS	1	0	0	

Individual Plant Bed Survey



Comments:

Shallow CHARA

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of 8

State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 6-6-06

SITE INFORMATION

Plant Bed ID: 03
Bed Size: 9.8
Substrate: 3
Marl? 0
High Organic? 0
Waterbody Name: Pretty Lake
Waterbody ID:
Total # of Species 9

CanopyAbundance at Site

S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

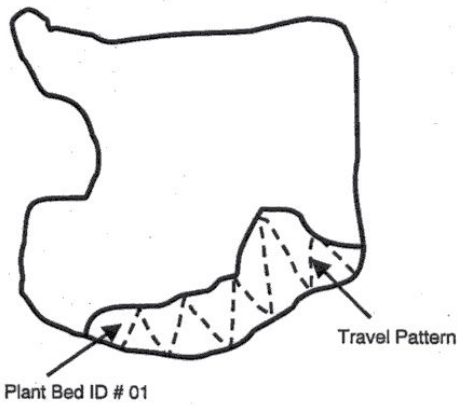
Center of the Bed
Latitude: N41.32765
Longitude: W86.37956

Max. Lakeward Extent of Bed
Latitude: N41.32739
Longitude: W86.37600

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POCR3	2	0	0	
POAM	2	0	0	
CEDE4	2	0	0	
POIL	1	0	0	
CHARA	1	2	0	
VAAM3	1	0	0	
NYTU	1	0	0	
POR1	1	0	0	

Individual Plant Bed Survey



Comments:

Dense Milfoil

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 4 of 8

State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 6-6-06

SITE INFORMATION

Plant Bed ID: 04
Bed Size: 1.4
Substrate: 2
Marl? 0
High Organic? 1

Waterbody Name: Pretty
Waterbody ID:
Total # of Species 9

CanopyAbundance at Site
S: 1 N: 1 F: 3 E: 1

SITE COORDINATES

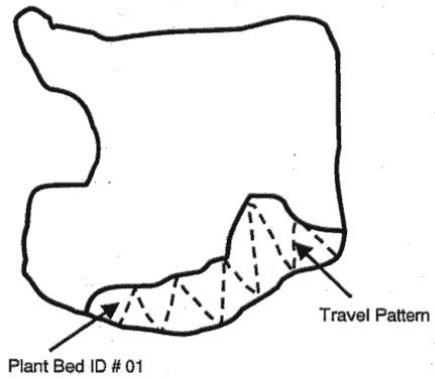
Center of the Bed
Latitude: N41.32756
Longitude: W86.37670

Max. Lakeward Extent of Bed
Latitude: N41.32763
Longitude: W86.37640

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	0	0	
VAAM3	1	0	0	
POAM	1	0	0	
MYSP2	1	0	0	
CHARA	3	2	0	
TYLA	1	0	0	
P. Loos LYSA	2	0	0	
NULU	1	0	0	
Pickerel POCO	1	0	0	

Individual Plant Bed Survey



Comments:

Shallow Lillies / Chara

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 5 of 8

State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 6-6-06

SITE INFORMATION

Plant Bed ID: 05
Bed Size: 23
Substrate: 2
Marl? 0
High Organic? 1
Waterbody Name: Pretty
Waterbody ID:
Total # of Species 8
CanopyAbundance at Site
S: 1 N: 1 F: 3 E: 1

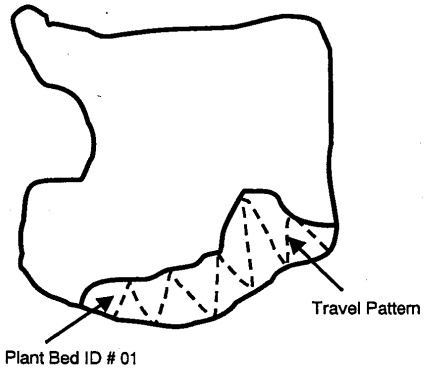
SITE COORDINATES

Center of the Bed
Latitude: N41.32564
Longitude: W86.37850
Max. Lakeward Extent of Bed
Latitude: N41.32560
Longitude: W86.37814

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NUAU	4	1	0	
NYTE	2	0	0	
CHARA	2	2	0	
MYSP2	1	0	0	
VAAM3	1	0	0	
POCO (Pickerel)	1	0	0	
LYSA (P. Loose)	2	0	0	
POAM	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
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QE Code:
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2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

AQUATIC CONTROL

Aquatic Vegetation Plant Bed Data Sheet

Page 6 of 8

State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 6-6-06

SITE INFORMATION

Plant Bed ID: 06
Bed Size: 0.8
Substrate: 2
Marl? 0
High Organic? 0

Waterbody Name: Pretty
Waterbody ID:
Total # of Species 4

CanopyAbundance at Site
S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

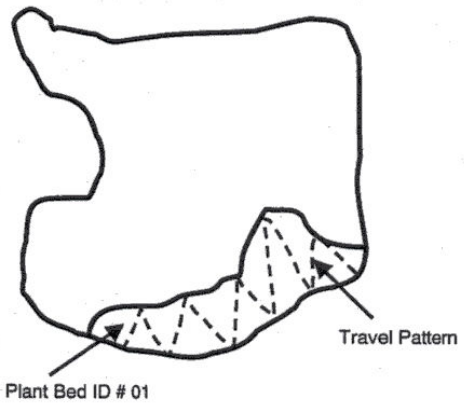
Center of the Bed
Latitude: N41.32626
Longitude: W86.37370

Max. Lakeward Extent of Bed
Latitude: N41.32625
Longitude: W86.37333

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POR1	1	0	0	
POAM	1	0	0	
CEDE4	2	0	0	

Individual Plant Bed Survey



Comments:
Hump w/ Dense EWM

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 6 of 8

State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 6-6-06

SITE INFORMATION

Plant Bed ID: 06
Bed Size: 0.8
Substrate: 2
Marl? 0
High Organic? 0

Waterbody Name: Pretty
Waterbody ID:
Total # of Species 4

Canopy Abundance at Site: S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

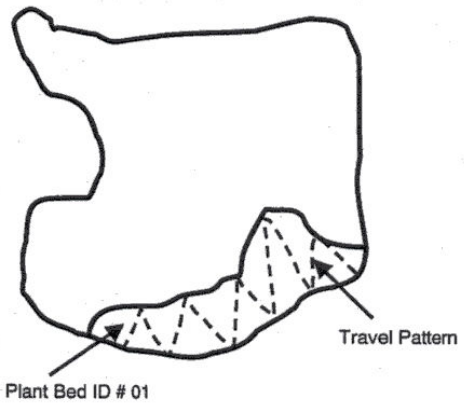
Center of the Bed
Latitude: N41.32626
Longitude: W86.37370

Max. Lakeward Extent of Bed
Latitude: N41.32625
Longitude: W86.37333

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
PORI	1	0	0	
POAM	1	0	0	
CEDE4	2	0	0	

Individual Plant Bed Survey



Comments: Hump w/ Dense EWM

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
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QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 7 of 8

State of Indiana Department of Natural Resources

ORGANIZATION: A.C

DATE: 6-6-06

SITE INFORMATION

Plant Bed ID: 07
Bed Size: 2.4
Substrate: 03
Marl? 0
High Organic? 0

Waterbody Name: Pretty
Waterbody ID:
Total # of Species 5

CanopyAbundance at Site

S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

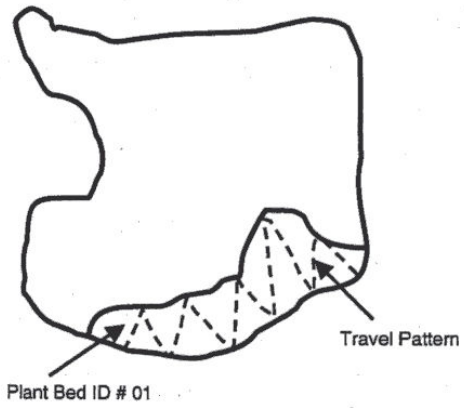
Center of the Bed
Latitude: N41.32799
Longitude: W86.37166

Max. Lakeward Extent of Bed
Latitude: N41.32704
Longitude: W86.37107

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POAM	3	0	0	
MYSP2	3	0	0	
POR1	1	0	0	
DOCR3	1	0	0	
CEDE4	1	0	0	

Individual Plant Bed Survey



Comments:

Large Mat / EWM Mix

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 8 of 8

State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 6-6-6

SITE INFORMATION

Plant Bed ID: 08
Bed Size: 0.2
Substrate: 6
Marl? 0
High Organic? 0
Waterbody Name: Pretty
Waterbody ID:
Total # of Species 3
CanopyAbundance at Site
S: 1 N: 1 F: 1 E: 1

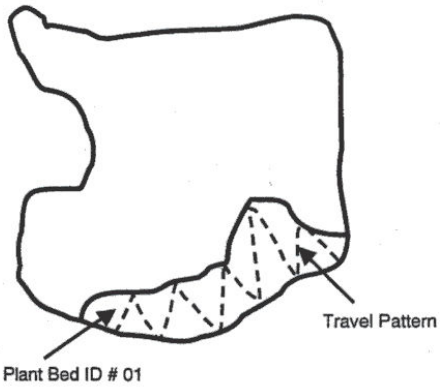
SITE COORDINATES

Center of the Bed
Latitude: N41.32324
Longitude: W86.37049
Max. Lakeward Extent of Bed
Latitude: N41.32333
Longitude: W86.37039

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
CHARA	1	2	0	
PORT	1	0	0	
VAAM3	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
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2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Tier 1

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization: Aquatic Control

Waterbody Name: Pretty Lake ID:

County: Marshall Date: 8-16-06

Habitat Stratum: IL Ave. Lake Depth (ft): 20 Lake Level:

GPS Metadata

Crew Leader: J. Leach

NAD27 | 3N | 16

Datum: Zone: Accuracy:

Recorder: K. McCreary Method: D

Secchi Depth (ft): 15.0 Total # of Plant Beds Surveyed: 5 Total # of Species: 10

Littoral Zone Size (acres): 324

- ☒ Measured
- ☐ Estimated

Littoral Zone Max. Depth (ft): 20+

- ☒ Measured
- ☐ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions:

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 5

State of Indiana Department of Natural Resources

ORGANIZATION: Aquatic Control

DATE: 8/16/06

SITE INFORMATION

Plant Bed ID: 1

Waterbody Name: Pretty Lake

Bed Size: 9.3

Substrate: 6

Waterbody ID:

Marl? 0

Total # of Species 6

High Organic? 0

CanopyAbundance at Site

S: 1 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.32546

Longitude: W86.36922

Max. Lakeward Extent of Bed

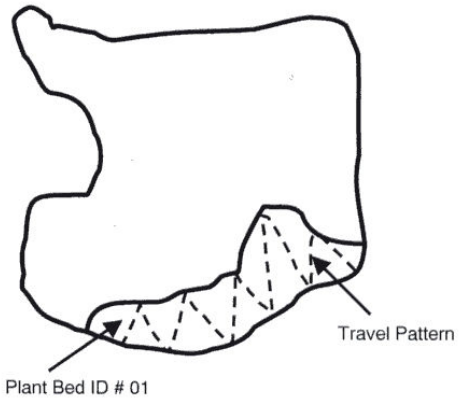
Latitude: N41.32651

Longitude: W86.37097

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
VAAM 3	~~3~~ 4	0	0	
POIL	3	0	0	
POAM	3	0	0	
CHAR	3	2	0	
MYSP2	3	0	0	
CEDE 4	4	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of 3

State of Indiana Department of Natural Resources

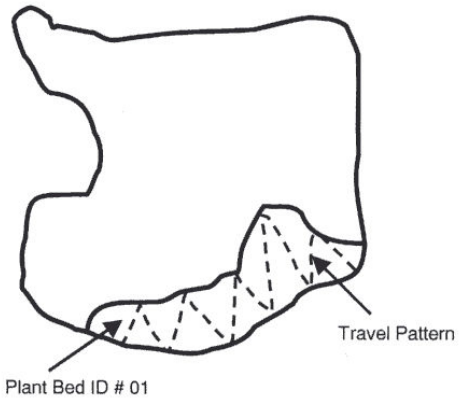
ORGANIZATION: Aquatic Control	DATE: 8/16/06

SITE INFORMATION		SITE COORDINATES
Plant Bed ID: 2	Waterbody Name: Pretty Lake	Center of the Bed
Bed Size: 6,8		Latitude: N 41.32337
Substrate: 6	Waterbody ID:	Longitude: W 86.37090
Marl? 0	Total # of Species 4	Max. Lakeward Extent of Bed
High Organic? 0	CanopyAbundance at Site	Latitude: N 41.32476
	S: 1 N: 1 F: 1 E: 1	Longitude: W 86.37487

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
CHARA	3	0	0	
POIL	2	0	0	
MYSP2	2	0	0	
VAAM3	2	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
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QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of 5

State of Indiana Department of Natural Resources

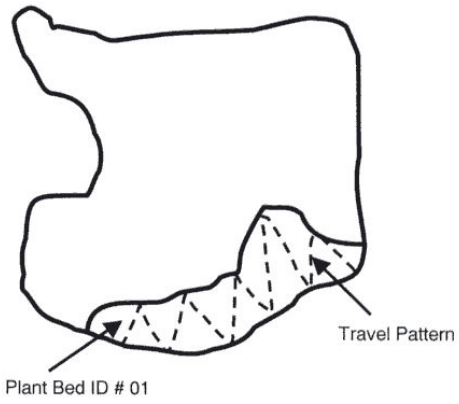
ORGANIZATION: Aquatic control DATE: 8/16/06

SITE INFORMATION					SITE COORDINATES
Plant Bed ID: 3	Waterbody Name: Pretty Lake				Center of the Bed
Bed Size: 12.2					Latitude: N 41.32761
Substrate: 3	Waterbody ID:				Longitude: W 86.37605
Marl? 0	Total # of Species 5				Max. Lakeward Extent of Bed
High Organic? 0	CanopyAbundance at Site				Latitude: N 41.32517
	S: 2	N: 1	F: 1	E: 1	Longitude: W 86.37482

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	3	0	0	
VAAM3	3	0	0	
POIL	2	0	0	
CEDE4	2	0	0	
CHAR	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 4 of 5

State of Indiana Department of Natural Resources

ORGANIZATION: Aquatic Control

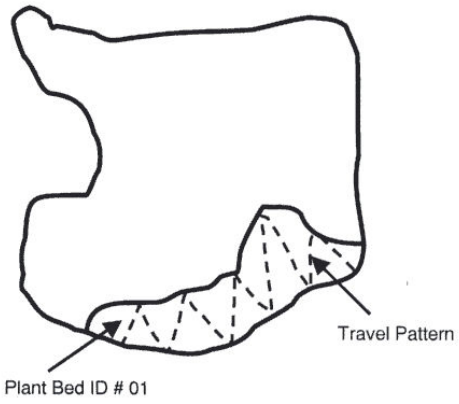
DATE: 8/16/06

SITE INFORMATION		SITE COORDINATES
Plant Bed ID: 4	Waterbody Name: Pretty Lake	Center of the Bed
Bed Size: 1.7		Latitude: N41.32796
Substrate: 3	Waterbody ID:	Longitude: W86.37591
Marl? 0	Total # of Species 4	Max. Lakeward Extent of Bed
High Organic? 0	CanopyAbundance at Site	Latitude: N41.32776
	S: 4 N: 1 F: 3 E: 1	Longitude: W86.37603

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	4	0	0	
CHAR	4	2	0	
CEDE4	1	0	0	
POIL	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 5 of 5

State of Indiana Department of Natural Resources

ORGANIZATION: Aquatic Control

DATE: 8/16/06

SITE INFORMATION

Plant Bed ID: 5

Bed Size: 2.4

Substrate: 2 & 3

Marl? 0

High Organic? 0

Waterbody Name: Pretty Lake

Waterbody ID:

Total # of Species 5

CanopyAbundance at Site

S: 4 N: 1 F: 3 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N 41.32604

Longitude: W 86.37853

Max. Lakeward Extent of Bed

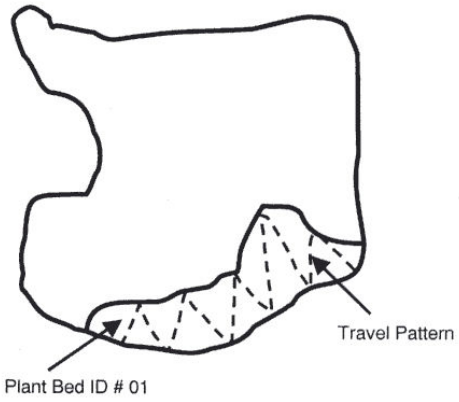
Latitude: N 41.32571

Longitude: W 86.37819

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NULM	4	0	0	
CHARC	4	0	0	
CEDE4	1	0	0	
POIL	1	0	0	
LYSA	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
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QE Code:
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1 = Species suspe
2 = Genus suspected
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Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Random Sampling

Waterbody Cover Sheet

Organization Name: Aquatic Control

Waterbody Name: Pretty Lake ID:

County: Marshal Date: 8-16-06

Habitat Stratum: 1L Ave. Lake Depth (ft): 20.0 Lake Level: Normal

Crew Leader: Joey Leach

GPS Metadata

Datum: Nad27 Zone: 3M Accuracy: 16

Recorder: K. McCreary Method: D

Secchi Depth (ft): 15.0 Total # of Sites Surveyed: 40 5 NV Total # of Species: 11

Littoral Zone Size (acres): 32.4

- [x] Measured
- [ ] Estimated

Littoral Zone Max. Depth (ft): 20+

- [x] Measured
- [ ] Estimate (historical Secchi)
- [ ] Estimated (current Secchi)

Notable Conditions:

APPENDIX A

Submersed Aquatic Plant Survey Form Page 1 of 2

WATER BODY NAME	Pretty Lake				SECCHI	15ft									
COUNTY	Marshall				MAX PLANT DEPTH	22ft									
DATE	8/16/06				WEATHER	Sunny 85°									
CREW LEADER	J. Leach				COMMENTS										
RECORDER	K. McCrary														
					Rake score (1-5), observed only (9), algae present (p)										
					Use acronyms for species, V1, V2...for voucher codes										Note
									Species Code						
Site	Northing	Easting	Depth	All	VAAM3	CHARA	MYSP2	POIL	POAM	CEDE4	NAFL	BIBE	POPU7	PORO	
241			2	5					5						
242			6	5		1		5							
243			14	5	1					5					
244			20	1			1	1		1					
245			4	3	1		1	3			1				
246			6	3			3	1							
247			12	5				3		5					
248			16	5	1			1		5					
249			4	3				3							
250			7	5	1		1	5							
251			17	5				5		5					
252			16	5	1		1			5	1				
253			5	5	1		5	1							
254			12	5						5					
255			5	5	5		1	3							
256			7	5			5								
257			17	5				1		5					
258			13	5	5		1			5					
259			6	5	5		3	3			1				
260			15	3	1		3								
261			5	5	3	1	1	1				5			
262			16	1	1								1		
263			5	5	1		5								
264			17	5						5					
265			7	5			5								
266			13	3			3								
267			12	5	3					3	1			3	
268			4	5	5										
269			10	5	3					5	3				
270			18	3						3					
271			11	5	5						3				
272			6	5	1		5								
Other plant species observed at lake															

NYTU
NULU

APPENDIX A

Submersed Aquatic Plant Survey Form

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WATER BODY NAME	Pretty Lake				SECCHI	15 ft									
COUNTY	Marshall				MAX PLANT DEPTH	20									
DATE	8/16/06				WEATHER	Sunny 85									
CREW LEADER	J. Lenarz				COMMENTS										
RECORDER	K. McCrary														
					Rake score (1-5), observed only (9), algae present (p)										
					Use acronyms for species, V1, V2…for voucher codes										Note
						EEG	Nuphar	EWM	Iris	Species Code	Coon		Slender		
Site	Northing	Easting	Depth	All	VAAM3	CHARA	MYSP2	POIL	POAM	CEOE4	NITE	NAFL			
273			6	5			1	5		5					
274			7	5			3	5							
275			20	3				1		3	1				
276			11	5	3					5		1			
277			4	5	1			5							
278			11	5	5		1			3					
279			16	5				1		5					
280			3	NP											
Other plant species observed at lake															

Plant Database

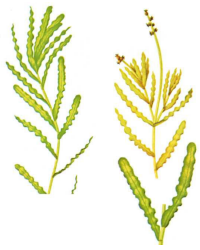
Date	Latitude	Longitude	Design	Site	Depth	RAKE	MYSP2	POIL	CEDE4	CH?AR	NAFL	POPU7	VAAM3	POAM	NI?TE	BIBE	PORO
8/16/06	41.32461	-86.368401		241	2.0	5								5			
8/16/06	41.32518	-86.368517		242	6.0	5		5		1							
8/16/06	41.32555	-86.369155		243	14.0	5			5				1				
8/16/06	41.32611	-86.369721		244	20.0	1	1	1	1								
8/16/06	41.32659	-86.36992		245	4.0	3	1	3			1		1				
8/16/06	41.32693	-86.370376		246	6.0	3	3	1	5								
8/16/06	41.32691	-86.371359		247	12.0	5		3	5								
8/16/06	41.32756	-86.371586		248	16.0	5		1					1				
8/16/06	41.32802	-86.371366		249	4.0	3		3									
8/16/06	41.3283	-86.371952		250	7.0	5	1	5					1				
8/16/06	41.32852	-86.372553		251	17.0	5		5	5								
8/16/06	41.32876	-86.373361		252	16.0	5	1		5		1		1				
8/16/06	41.32912	-86.373651		253	5.0	5	5	1					1				
8/16/06	41.32867	-86.374187		254	12.0	5			5								
8/16/06	41.32857	-86.374922		255	5.0	5	1	3					5				
8/16/06	41.32834	-86.374831		256	7.0	5	5										
8/16/06	41.32802	-86.375016		257	17.0	5		1	5								
8/16/06	41.32775	-86.375567		258	13.0	5	1		5				5				
8/16/06	41.32765	-86.376043		259	6.0	5	3	3			1		5				
8/16/06	41.32738	-86.376188		260	15.0	3	3	1					1				
8/16/06	41.32733	-86.376988		261	5.0	5	1			1			3			5	
8/16/06	41.327	-86.377401		262	16.0	1						1	1				
8/16/06	41.32685	-86.377872		263	5.0	5	5						1				
8/16/06	41.32653	-86.377714		264	17.0	5			5								
8/16/06	41.32622	-86.377882		265	7.0	5	5										
8/16/06	41.32598	-86.377854		266	13.0	3	3										
8/16/06	41.32538	-86.377888		267	12.0	5			3				3				3
8/16/06	41.32495	-86.377714		268	4.0	5							5				
8/16/06	41.32472	-86.377124		269	10.0	5			5		3		3				
8/16/06	41.32466	-86.376407		270	18.0	3			3								
8/16/06	41.32474	-86.375805		271	11.0	5					3		5				
8/16/06	41.3249	-86.374972		272	6.0	5	5						1				
8/16/06	41.32613	-86.373873		273	6.0	5	1	5	5								
8/16/06	41.32638	-86.374112		274	7.0	5	3	5									
8/16/06	41.32416	-86.37397		275	20.0	3		1	3						1		
8/16/06	41.32378	-86.373224		276	11.0	5			5		1		3				
8/16/06	41.32352	-86.37192		277	4.0	5		5					1				
8/16/06	41.32349	-86.370882		278	11.0	5	1		3				5				
8/16/06	41.3234	-86.369953		279	16.0	5		1	5								
8/16/06	41.32395	-86.368661		280	3.0	0											

16.2 Species List. Macrophyte List for the Pretty Lake

Common Name	Scientific Name	2006 Tier I	2006 Tier II
Bur Marigold	*Bidens beckii*		X
Chara	*Chara spp.*	X	X
Common cattail	*Typhia latifolia*	X	
Common coontail	*Ceratophyllum demersum*	X	X
Curlyleaf pondweed	*Potamogeton crispus*	X	
Eel grass	*Valisneria americana*	X	X
Eurasian watermilfoil	*Myriophyllum spicatum*	X	X
Illinois pondweed	*Potamogeton illinoensis*	X	X
Largeleaf pondweed	*Potamogeton amplifolius*	X	X
Leafy pondweed	*Potamogeton foliosus*	X	
Nitella	*Nitella spp.*		X
Pickeral weed	*Pontederia cordata*	X	
Purple loosestrife	*Lythrum salicaria*	X	
Richardson's pondweed	*Potamogeton richardsonii*	X	
Slender naiad	*Najas flexilis*	X	X
Small pondweed	*Potamageton pusillus*	X	X
Spatterdock	*Nuphar advena*	X	
White water lily	*Nymphaea odorata*	X	
Variable watermilfoil	*Myriophyllum heterophyllum*	X	
White water lily	*Nymphaea odorata*	X	

Chara (*chara spp.)* is an anchored green algae with whorled, branchlike filaments at the nodes of a central axis. Often times mistaken for vascular plants. Typically inhabits shallow water. Provide food and cover for wildlife. Rarely reaches the surface of the water and rarely causes problem.

Common coontail (*Ceratophylum demersum*) is a commonly occurring aquatic plant in the Midwest in neutral to alkaline waters[1]. It is a submersed dicot with coarsely toothed leaves whorled about the stem[2]. This plant is given its name due to its resemblance to the tail of a raccoon. Coontail has been found to be an important food source for wildfowl as well as a good shelter for small animals[2]. This plant is also a good shelter for young fish, and support of insects[2], but has been known to crowd out other species of aquatic plants[3].



Curlyleaf pondweed (*Potamogeton crispus*) is a submersed monocot with slightly clasping, rounded tip leaves. The flowers occur on dense cylindrical spikes and produces distinctive beaked fruit[1]. Curly leaf is eaten by ducks, but may become a weed[2]. This plant provides good food, shelter, and shade for fish and is important for early spawning fish like carp and goldfish[2].

Eurasian watermilfoil (*Myriophyllum spicatum*) is an exotic aquatic plant that has been known to crowd out native species of plants. This species spreads quickly because it can grow from very small plant fragments and survive in low light and nutrient conditions[3]. This dicot has stems that typically grow to the water surface and branch out forming a canopy that shades other species of aquatic plants. Eurasian water-milfoil has characteristic red to pink flowering spikes that protrude from the water surface one to two inches high[1]. The segmented leaves grow in whorls of three to four around the stem[1]. It can grow from very small plant fragments and survive in low light and nutrient conditions. This dicot has stems that typically grow to the water surface and branch out forming a canopy that shades other species of aquatic plants.

[1] Chadde, S. 1998. Great lakes wetland flora. Pocketflora Press, Calumet, Michigan.

[2] Fassett, N. 1957. A manual of aquatic plants, 2nd edition. The University of Wisconsin Press, Madison, Wisconsin.

[3]Applied Biocehmists, 1998. Water weeds and algae, 5th edition. Applied Biochemists, J. C. Schmidt and J. R. Kannenberg, editors. Milwaukee, Wisconsin. (all plant illustrations supplied by Applied Biochemist)

16.3 IDNR VEGETATION PERMIT

APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT
State Form 26727 (R / 11-03)
Approved State Board of Accounts 1987
[x] Whole Lake [ ] Multiple Treatment Areas
Check type of permit

INSTRUCTIONS: Please print or type information

FOR OFFICE USE ONLY
License No.
Date Issued
Lake County

Return to: Page 1 of 2
DEPARTMENT OF NATURAL RESOURCES
Division of Fish and Wildlife
Commercial License Clerk
402 West Washington Street, Room W273
Indianapolis, IN 46204

FEE: $5.00

Applicant's Name	Lake Assoc. Name	
Pretty Lake Association	Pretty Lake Association	
Rural Route or Street: 319 W. Jefferson St.		Phone Number: 574-935-0610
City and State: Plymouth, IN		ZIP Code: 46563
Certified Applicator (if applicable)	Company or Inc. Name	Certification Number
Rural Route or Street		Phone Number
City and State		ZIP Code

Lake (One application per lake)	Nearest Town	County
Pretty Lake	Plymouth	Marshall
Does water flow into a water supply	[ ] Yes	[x] No

Please complete one section for *EACH* treatment area. Attach lake map showing treatment area and denote location of any water supply intake.

Treatment Area # 1	LAT/LONG or UTM's whole lake fluridone	
Total acres to be controlled 97	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft)	Expected date(s) of treatment(s) early May	

Treatment method: [x] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. whole lake fluridone treatment (see 2006 AVMP)

Plant survey method: [x] Rake [x] Visual [ ] Other (specify) Summarized from June Sampling

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian watermilfoil	x	50
Largeleaf pondweed		25
Curlyleaf pondweed	x	10
Illinois pondweed		4
Richardson's pondweed		3
Chara spp.		1
White water lily		1
Eel Grass		1
Coontail		1
Bur Marigold (sampled in August at 1 location)		1
leafy pondweed		1
small pondweed		1
pickeral weed		1

AQUATIC CONTROL

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Treatment Area #	LAT/LONG or UTM's	
Total acres to be controlled	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft)	Expected date(s) of treatment(s)	

Treatment method: ☐ Chemical ☐ Physical ☐ Biological Control ☐ Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control.

Plant survey method: ☒ Rake ☒ Visual ☐ Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community

INSTRUCTIONS: Whoever treats the lake fills in "Applicant's Signature" unless they are a professional. If they are a professional company who specializes in lake treatment, they should sign on the "Certified Applicant" line.

Applicant Signature	Date
Certified Applicant's Signature	Date

FOR OFFICE ONLY

☐ Approved ☐ Disapproved	Fisheries Staff Specialist
☐ Approved ☐ Disapproved	Environmental Staff Specialist

Mail check or money order in the amount of $5.00 to:

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
COMMERCIAL LICENSE CLERK
402 WEST WASHINGTON STREET ROOM W273
INDIANAPOLIS, IN 46204

AQUATIC CONTROL

16.4 PUBLIC INPUT QUESTIONARE

Lake Use Survey Lake name_____

Are you a lake property owner? Yes_____ No_____

Are you currently a member of your lake association? Yes ___ No___

How many years have you been at the lake?
2 or less
2 – 5 years
5-10 years
Over 10 years

How do you use the lake (mark all that apply)
___Swimming ___Irrigation
___Boating ___Drinking water
___Fishing ___Other _____

Do you have aquatic plants at your shoreline in nuisance quantities? Yes ___ No ___

Do you currently participate in a weed control project on the lake? Yes ___ No ___

Does aquatic vegetation interfere with your use or enjoyment of the lake? Yes ___ No___
Does the level of vegetation in the lake affect your property values? Yes ___ No ___

Are you in favor of continuing efforts to control vegetation on the lake? Yes ___ No ___

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded? Yes ___ No ___

Mark any of these you think are problems on your lake:
___ Too many boats access the lake
___ Use of jet skis on the lake
___ Too much fishing
___ Fish population problem
___ Dredging needed
___ Overuse by nonresidents
___ Too many aquatic plants
___ Not enough aquatic plants
___ Poor water quality
___ Pier/funneling problem

Please add any comments:

_____

_____

16.5 RESOURCES FOR AQUATIC VEGETATION MANAGEMENT

Books
Aquatic Plant Management in Lakes and Reservoirs
Aquatic Plants of Illinois
A Manual of Aquatic Plants
Managing Lakes and Reservoirs
Interactions Between Fish and Aquatic Macrophytes in Inland Waters
Lake and Reservoir Restoration

Societies/Wesites
Aquatic Plant Management Society-apms.org
Midwest Aquatic Plant Management Society-mapms.org
North American Lake Management Society-nalms.org
Indiana Lake Management Society-indianalakes.org
Aquatic Control Inc.-aquaticcontrol.com